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PALAEMONS OF THE PHILIPPINE ISLANDS

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Three plates and 1 text figure

The palaemons are widely distributed over the world, but are usually confined to the fresh-water lakes and rivers of tropical and subtropical countries. A few species, however, inhabit the temperate regions and some live in the sea and in brackish water. In the Philippine Islands this genus is well represented, and especially is this the case in the lakes and rivers near Manila where several species are very abundant. The palaemons, commonly but incorrectly spoken of as "shrimps" or "lobsters," appear occasionally in our markets, and are considered an excellent food, being even more highly esteemed than the so-called "salt water shrimps" belonging to the genus *Penaeus*. They form an important article of food for the Filipinos who live inland; consequently, most of them are purchased before they reach the markets of such coast cities as Manila.

A glance at a map of the Philippines shows how rich the Islands are in rivers and streams which flow to the sea. It is safe to say that all of them contain palaemons and that these are used by the Filipinos for food. I have collected these crustaceans from streams near Port Galera on Mindoro Island, from streams at Taytay on Palawan Island, from a small river at Sisiman on Luzon Island, and from Mariquina, San Juan, and Pasig Rivers near Manila. In addition to specimens from the

above-mentioned localities, we have in our collection specimens from Gandara, Samar Island; from Lake Lanao, Mindanao Island; from Jaro, Leyte Island; and from Pampanga River, Luzon Island.

While the palaemon fishery in the Philippines is not so large as some other fisheries, it is an industry which is carried on all over the Islands and is one which deserves to be improved if possible. The French people are famous for the way in which they have cultivated the fresh-water crayfish in France, and even here near Manila it is said that an attempt has been made to grow palaemons in some of the fishponds. A series of experiments conducted on a scientific and practical basis would be of great value to this industry.

METHODS USED IN FISHING

At least seven methods of fishing for palaemons are employed in the Philippine Islands. (1) The larger forms are often caught in a large fish trap known as the *baclad*. This consists of a split bamboo fence arranged in the form of a V. The palaemons follow the two wings of the V until they reach a narrow opening at the angle, through which they pass into an inclosure. The narrow opening is guarded by pieces of bamboo which point inward and prevent the crustaceans from escaping. (2) The smaller forms are frequently caught by men and boys who dive and feel about in holes and crevices for them. (3) Another trap which is used is the *bobo*, a rectangular box made of bamboo. The bobo is filled with hay or grass through an opening in one side, and is then lowered to the bottom. It is allowed to remain in the water for two or three weeks until the hay or grass has decayed, after which the palaemons enter to feed on the material and the trap is hauled up. (4) The familiar cast net is also used in shallow water where the palaemons can be seen. It has been given the name *dala* by the Filipinos. (5) Another familiar way of catching these crustaceans is by hauling an ordinary seine. This seine, which is provided with a pocket, is called *pukot*. (6) A method frequently employed is the following: Two men are seated in a banca, the one in the bow handles a dip net and the other in the stern does the paddling. The frame to which the net is attached is triangular, and is firmly attached at one angle to a long handle. This net is held close to the bottom where it catches the palaemons as the banca moves forward. (7) The *talabog* consists of a large bundle of roots bound together at both ends. This is lowered into the water and the palaemons instinctively cling to it or hide among the roots.

When the talabog is brought to the surface, they still remain attached. On Mindoro there is a modification of this method. Instead of the roots, a large bundle of leaves baited inside with cooked rice is used.

VALUE OF THE FISHERY

The commercial value of the palaemon fishery is difficult to estimate. Many Filipinos living along the banks of the rivers and lakes catch only enough for their own use. Fishermen who make a business of catching palaemons usually retail their catch in the locality where they live; and in the neighborhood of towns or cities, as an example, Manila, the catches are not taken to the markets unless they are large.

The price varies a little with the abundance of the catch. Very small individuals, those from 1 to 2 centimeters long, are sold by measure, while those from 10 to 15 centimeters long bring about 2 or 3 centavos[1] each. Palaemons larger than these are sold for 20, 30, or 40 centavos, while the largest with a body length of from 30 to 35 centimeters bring from 40 to 50 centavos each. I have been told that larger specimens than any in our collection are caught occasionally and that these may bring as much as 80 centavos.

The palaemon fishery is at its height during the hot and rainy seasons, and it is then that the bulk of the year's catch is made. Unfortunately, it is at this time that the breeding occurs in most of the species. One of the most successful fishermen living on the banks of San Juan River at the town of San Juan del Monte states that he and another fisherman, together with three helpers, catch from 20,000 to 25,000 palaemons in a season and that these net from about 540 to 550 pesos. There are a few other fishermen farther up the river whose business is not so large, but it is safe to say that the total value of the palaemon fishery in this one river easily reaches 2,000 pesos in one season.

In Pasig River and, especially, where it and its branches have their origin from Laguna de Bay, the palaemon fishery is of much more importance than that in San Juan River. A trip from the barrio of Tagig along one of the smaller branches of Pasig River to Laguna de Bay will convince one of this. One bank of this stream is lined by fishermen's houses, each with its small baclad for catching the kind of palaemon that is sold by measure, and where the stream widens out as it issues from Laguna de Bay one may see several hundred of the large baclads

[1] One centavo equals 0.5 cent United States currency; 100 centavos equal 1 peso or 50 cents United States currency.

planted in the shallow water. It is in these large baclads that during the months of April, May, June, July, and August, especially, a local form of *Palaemon carcinus* Fabricius of India is caught in great numbers. The fishery in this region must amount to from 20,000 to 25,000 pesos per year.

EXTERNAL CHARACTERS OF A PALAEMON

As it is the purpose of this paper to describe the various species of Philippine palaemons so that people in the Philippine Islands who are not zoölogists may be able to identify specimens, I shall devote a little space to a simple description of the external anatomy of a palaemon (fig. 1).

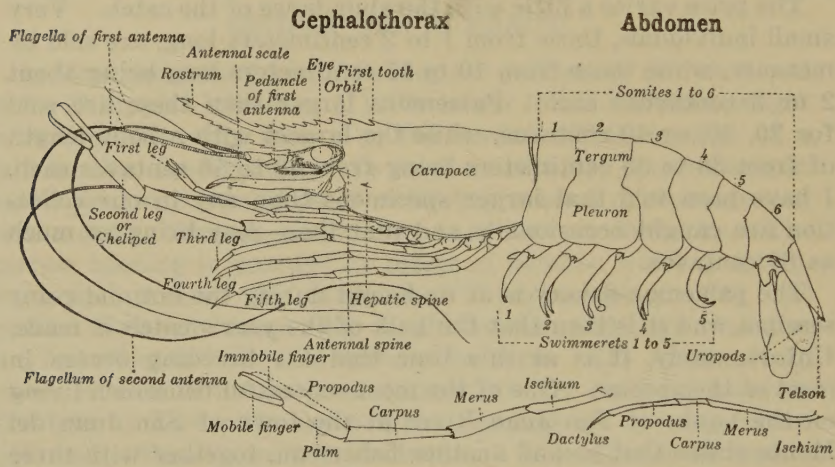

FIG. 1. Diagram of a palaemon.

The body of the palaemon may be divided into a forward or anterior part known as the cephalothorax and a hind or posterior jointed part known as the abdomen. The cephalothorax is composed of a head and a thorax which are so closely joined together that there is no neck, and it is covered above—dorsally—and on the side—laterally—by a tough shield-shaped carapace. From the front of the carapace a pointed beak or rostrum extends forward, and is armed with teeth along its dorsal and its lower—ventral—border. The "first tooth" in the following description means the most posterior tooth arising from the carapace and the number of teeth on the dorsal and ventral borders of the rostrum is indicated in the form of a fraction which I have called the rostral or dental formula $\left(\frac{10, 11, 12, 13}{3, 4}\right)$. There are 2 spines on each side of the carapace near the

anterior border. The upper one is called the antennal spine; the lower one, the hepatic spine. On each side of the rostrum where it has its origin from the carapace is an eye mounted on a stalk. The stalk occupies a little niche in the carapace known as the orbit. Extending forward from the base of the eye stalk along each side of the lower border of the rostrum is a peculiar structure known as the peduncle of the first antenna. Each one bears a pair of whiplike flagella. The outer flagellum of the pair has a short branch arising near its origin from the peduncle. Below the peduncle of the first antenna on each side of the rostrum lies a large scalelike structure known as the antennal scale. From the underside of each scale where it has its origin from the cephalothorax arises the long whiplike flagellum of the second antenna. On the lower side of the cephalothorax are attached 5 pairs of leglike structures, which are known as the first, second, third, fourth, and fifth pairs of legs. The chelipeds (second pair of legs) are much larger than the others, and terminate in pincers. The first legs, which are much shorter and slenderer than the chelipeds, have their origin from the cephalothorax in front of the origin of the chelipeds, and are usually folded once under the body. They also terminate in small pincers. The third, fourth, and fifth legs are slenderer and shorter than the chelipeds, but stouter than the first legs. They do not end in pincers. Each leg consists of jointed pieces or segments. The segments of the cheliped are as follows: The pincers are made up of 2 fingers, which are armed with teeth. One of these is movable, and is known as the mobile finger; the other is known as the immobile finger, and is continuous with a thick piece known as the palm. The immobile finger and the palm are often spoken of as the propodus. The propodus, including the mobile finger, is called the chela. The segment next to the chela is the wrist or carpus, which is joined to another segment known as the merus. Finally, the last piece or ischium follows the merus and is attached to the cephalothorax by 2 very short pieces, the names of which it is not necessary for us to consider. The first leg is made up of the same number of segments as the cheliped, and these have the same names.

The back or posterior portion of the body, which is often bent under, is known as the abdomen, and is composed of 7 pieces, the first 6 of which are known as somites. The seventh or terminal piece, which is pointed, is called the telson. Each somite has a tough covering, the dorsal surface and part of the lateral surface of which are known as the tergum. The lower part of the lateral surface is called the pleuron. Each

of the first 5 somites has a pair of branched structures attached to its lower surface, which are known as swimmerets, and the sixth somite has a somewhat similar but larger pair called the uropods. The uropods and the telson together make up the tail fin.

While zoölogists might have no difficulty in identifying palaemons among a number of other crustaceans more or less related, one who is not specializing in this line might have considerable trouble. For this reason, I shall compare several forms found in the waters about Manila which might be mistaken for them. One of the commonest crustaceans, which may be seen almost any day in our markets, is the "salt water shrimp" belonging to the genus *Penaeus*. This can be distinguished from the palaemon by the more or less evident keellike ridge on the dorsal surface of the posterior part of the abdomen, by the absence of large legs, and by the presence of pincers on the first, second, and third legs.

The pistol crab, belonging to the genus *Alpheus*, is occasionally seen in the markets, and differs from the palaemons in the following particulars: The rostrum is very small or absent, the first legs are strong and provided with pincers, the second legs are weak and have small pincers, and the third, fourth, and fifth legs are weak and without pincers.

Another form which is used for food by Filipinos, although not highly thought of, belongs to the genus *Atya*, and is found in mountain streams. It may be distinguished easily from the palaemons by the peculiar pincers of the first and second legs. These pincers are provided with brushes of hairs which are used to catch mud and minute organisms. The third, fourth, and fifth legs have no pincers.

Finally, I shall mention the large brillantly colored "sea crawfish" or "spiny lobster" (*langosta del mar*) belonging to the genus *Palinurus*. It lives along rocky shores washed by the open sea, and is occasionally seen in our markets. All five legs are without pincers, and the antennæ are very long and spiny.

PHILIPPINE SPECIES OF THE GENUS PALAEMON

Palaemon carcinus Fabricius. Plate I, figs. 1 and 1*a-j*.

The largest palaemon in our collection, and undoubtedly the largest one in the Philippine Islands, I have diagnosed as *Palaemon carcinus* Fabricius. This conclusion was arrived at after a careful study of a large series, although a comparison

of this series with individuals of the Indian species shows certain distinct and constant differences. The local form differs slightly from typical *P. carcinus* in the shape of the rostrum, the rostral formula, the arrangement of the teeth on the rostrum at all ages, and the position of the tip of the rostrum with reference to the tip of the antennal scale at different ages; there is, however, a close similarity in the shape, armature, and proportions of the segments of the chelipeds. The characters of the chelipeds, just mentioned are of great diagnostic value in determining species of the genus *Palaemon,* and for this reason I have not described it as a new variety. It should be mentioned, however, that our local form of *Palaemon carcinus* probably closely resembles a form originally known as *Palaemon rosenbergii* de Man,[2] but which is now considered by de Man,[3] Ortmann,[4] and others as a variety of *P. carcinus.* The original description of *P. rosenbergii* was based upon a single full-grown female, and as no male has been seen I shall not place our local form under de Man's variety. However, his description agrees closely with a female specimen of about the same size which is in our collection. The shape, size, and toothing of the rostrum, as well as the measurements of the chelipeds, are almost identical.

The detailed description of the Philippine form of *P. carcinus* which follows is considered advisable, because our form differs from the type, because our collection affords a large number of different ages and sexes, and because it is the most important species from a commercial point of view in the Philippine Islands.

Rostrum and antennal scale.—An examination of 21 female specimens, varying in body length [5] from 115 to 250 millimeters, shows with one exception that the rostrum extends beyond the antennal scale. This exception (230 millimeters long) has a rostrum which appears to be normal, but the tip just reaches the distal end of the scale. In the largest specimen (250 millimeters), however, the tip extends slightly beyond, while in a young female (115 millimeters) the rostrum extends one-fourth of its length beyond the end of the antennal scale. Thirty-six

[2] *Notes Leyden Mus.* (1879), 1, 167.

[3] Zoologische Ergebnisse einer Reise in Niederländish Ost-Indien (1892), 2, 417.

[4] *Zool. Jahrb., Systematik* (1891), 5, 701.

[5] By body length, or length, is meant the distance from the tip of the rostrum to the tip of the telson.

TABLE I.—*Palaemon carcinus Fabricius.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Length (posterior face of eye to posterior end of telson).	Position of peduncle of first antennæ with reference to rostral teeth.	Extension of first pair of legs beyond antennal scale.	Extension of chelipeds beyond antennal scale.
		mm.	*mm.*			
1	♂	100.0	70.5	Extends to third tooth of ventral border	Propodus beyond	One-fourth of carpus beyond.
2	♂	125.0	89.0	Between third and fourth tooth	One-half of propodus	One-half of carpus.
3	♂	133.5	99.5	Fourth tooth	do	One-third of carpus.
4	♂	138.0	100.5	Between third and fourth	Almost whole of propodus beyond	Do.
5	♂	[b] 138.0	106.0	Fourth	Propodus and 3 mm. of carpus	One-half of carpus.
6	♂	146.0	110.0	do	Propodus	Do.
7	♂	152.0	110.0	Third and fourth	Propodus and 1 mm. of carpus	More than one-half of carpus.
8	♂	164.0	125.5	Fourth	do	One-half of carpus.
9	♂	185.5	139.0	Fourth and fifth	do	Do.
10	♂	[a] 186.5	149.0	Fifth	Propodus	More than one-half of carpus.
11	♂	192.5	152.0	Fifth and sixth	Propodus and about 2 mm. of carpus	More than three-fourths of carpus.
12	♂	204.0	163.5	do	Propodus and one-fourth of carpus	Almost whole of carpus.
13	♂	240.0	187.0	do	do	Three-fourths of carpus.
14	[b] ♂	240.0	196.0	Seventh and eighth	Propodus and one-half of carpus	Two-thirds of merus.
15	[b] ♂	280.0	232.0	Almost to last tooth on ventral border	do	One-half of merus.
16	[b] ♂	320.0	263.0	To penultimate tooth on ventral border	Propodus and one-fifth of carpus	Do.
17	♀	115.0	80.0	Third and fourth	Propodus	One-fifth of carpus.
18	♀	116.0	83.0	Fourth	do	One-third of carpus.
19	♀	154.0	115.0	do	do	One-half of carpus.
20	♀	158.0	119.0	Fourth and fifth	do	Do.
21	♀	[c] 164.0	26.0	Missing	Propodus and 1 mm. of carpus	Do.
22	♀	[d] 172.0	128.0	Fourth	Propodus	Do.
23	♀	[c] 179.0	131.0	Third and fourth	Two-thirds of propodus	Two-fifths of carpus.
24	♀	[c] 194.0	147.0	Fourth and fifth	Propodus and 2 mm. of carpus	Three-fifths of carpus.

25	♀	[d] 214.0	164.5	----do	Propodus and 5 mm. of carpus	Four-fifths of carpus.
26	♀	[c] 230.0	179.0	Sixth and seventh	Propodus	Do.
27	♀	[d] 248.0	188.0	Fourth and fifth	Propodus and 7 mm. of carpus	Almost whole of carpus.

No.	Sex.	Chelipeds.								
		Length of—						Felt on mobile finger.	Gape of fingers.	Teeth on fingers.
		Propodus.	Finger.	Palm.	Carpus.	Merus.	Ischium.			
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			
1	♂	15.0	6.0	8.0	13.0	10.5	9.4	Absent	None	Absent.
2	♂	24.5	12.0	12.5	18.5	15.0	13.5	----do	----do	Beginning to form.
3	♂	26.0	13.0	13.0	19.0	15.0	14.0	----do	----do	Increasing in size.
4	♂	27.0	13.5	13.5	19.0	16.0	15.0	----do	----do	Do.
5	♂	30.0	15.0	15.0	21.5	18.0	16.5	Small amount on proximal half.	----do	Do.
6	♂	30.0	15.0	15.0	22.5	18.0	16.5	Increasing	----do	Do.
7	♂	34.0	17.0	17.0	23.0	20.0	18.0	----do	Present	Do.
8	♂	42.0	20.0	22.0	25.0	21.0	19.5	----do	Increasing	Do.
9	♂	46.0	21.5	24.5	26.0	23.5	20.5	----do	----do	Do.
10	♂	51.0	24.0	27.0	28.5	26.0	22.0	----do	----do	Do.
11	♂	68.0	32.0	36.0	38.0	33.0	27.5	Four-fifths covered	----do	Becoming conspicuous.
12	♂	76.0	36.0	40.0	42.5	36.5	29.5	----do	----do	Increasing in size.
13	♂	79.0	36.0	43.0	47.0	38.0	34.0	----do	----do	Do.
14	[b] ♂	159.0	67.0	92.0	111.0	87.0	44.0	Very thick	Conspicuous	Do.
15	[b] ♂	177.0	71.0	106.0	111.0	95.0	47.0	----do	----do	Do.
16	[b] ♂	207.0	85.0	122.0	122.0	100.0	57.0	----do	----do	Do.
17	♀	17.0	8.5	8.5	13.5	12.0	12.0	Absent	No gaping	Visible with lens.
18	♀	16.5	7.5	9.0	16.5	12.0	12.0	Small amount on proximal half.	----do	Do.

[a] Tip broken. [b] Chelipeds enormously developed. [c] With eggs. [d] Eggs shed.

TABLE I.—*Palaemon carcinus Fabricius*—Continued.

No.	Sex.	Chelipeds.								
		Length of—						Felt on mobile finger.	Gape of fingers.	Teeth on fingers.
		Propodus.	Finger.	Palm.	Carpus.	Merus.	Ischium.			
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			
19	♀	29.0	12.5	16.5	22.0	18.5	18.0	Two-thirds	Gaping	Visible with lens.
20	♀	28.0	13.0	15.0	26.0	18.5	20.5	Four-fifths	do	Increasing in size.
21	♀	34.5	16.0	18.5	27.0	22.0	19.0	Two-thirds	do	Do.
22	♀	30.0	14.0	16.0	26.5	20.0	20.0	do	do	Do.
23	♀	30.5	14.0	16.5	26.5	20.5	20.0	do	do	Do.
24	♀	39.5	18.0	21.5	33.5	25.0	25.0	do	Gape increasing	Do.
25	♀	56.0	26.0	30.0	44.5	32.0	31.0	Four-fifths	do	Do.
26	♀	69.0	32.0	37.0	46.0	35.5	33.0	do	do	Do.
27	♀	78.5	33.0	45.5	47.0	39.0	36.0	do	do	Do.

male individuals (short chelipeds),[6] varying in body length from 100 to 240 millimeters, show that the rostrum overreaches the antennal scale. In specimens from 100 to 110 millimeters long the rostrum extends almost one-third of its length beyond the antennal scale, and this distance gradually decreases until in individuals 240 millimeters long it overreaches the antennal scale only slightly. Finally, in 4 large males (chelipeds enormously developed) measuring from 250 to 320 millimeters, the rostrum fails to reach the tip of the scale. In fact, in another male only 240 millimeters long but with the chelipeds enormously developed the condition is similar. While this gradual decrease in the length of the rostrum might be explained by the assumption that during the life of these palaemons the tip is repeatedly broken off and then partially regenerated, it is hard to believe that such is the case, considering the uniform character of the decrease shown by the series at hand.

The descriptions or figures of *Palaemon carcinus* by Fabricius,[7] Herbst,[8] M. Milne-Edwards,[9] Ortmann,[10] de Man,[11] and Henderson and Matthai [12] all indicate that the rostrum extends beyond the antennal scale, while Henderson's [13] description and Rumphius's [14] figure show that these authors have examined some specimens in which the rostrum extends to the tip of the antennal scale only or fails to reach it. Von Martens [15] mentions the fact that the rostrum of *Palaemon carcinus* from Luzon is strikingly short. Henderson finds great variation in the length of the rostrum of *P. carcinus* from India, some specimens showing the rostrum scarcely longer than the scale. This fact and others leave him in considerable doubt as to the limitations of

[6] In our collection, except in one case, male specimens of *P. carcinus*, from the shortest to those 240 millimeters long, have the short weakly developed chelipeds like those of the female, but in males 250 millimeters long, or longer, the chelipeds are enormously developed.

[7] Fabricii Entomologia Systematica Supplementum (1798), 5, 402.

[8] Versuch einer Naturgeschichte der Krabben and Krebse (1796), 2, Tab. XXVIII, Fig. 1.

[9] Histoire Naturelle des Crustaces (1837), 2, 395.

[10] *Zool. Jahrb. Systematik* (1891), 5, 701.

[11] Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien (1892), 2, 414.

[12] *Records Indian Mus.* (1910), 5, Pl. XV, fig. 1a. Henderson and Matthai, in the general part of their paper on palaemons, state that the rostrum in the young is relatively longer than in the adults and that it is usually relatively longer in females than in males.

[13] *Trans. Linn. Soc. London*, Zool. (1893), 5, 411.

[14] D'Ambonische Rariteitkamer (1741), Pl. I, fig. B.

[15] *Arch. f. Naturgesch.* (1868), 5, 35.

the species, and he is forced to regard such species as belonging to a variety in which the apical growth of the rostrum has been arrested. It does not seem to me probable that the gradual decrease in length between the tip of the antennal scale and the tip of the rostrum, which is so strikingly illustrated in our series, is unique for the form we have here in the Philippines. On the contrary, I believe that an examination of a large series of *P. carcinus* from India will show a similar condition, and I am inclined to agree with that part of Henderson's statement in which he says that the apical growth of the rostrum may be arrested. From a study of specimens of *Palaemon carcinus* and *Palaemon philippinensis* sp. nov., I believe that the growth of the rostrum becomes partially arrested when the so-called mature characters are acquired and that this change is especially marked in the males.

Curvature and dental formula of rostrum.—Females of all ages show the distal one-third of the rostrum curved upward, but this is more evident in the young than the old. The arching over the eye, which is pronounced in *Palaemon carcinus* from India, is not conspicuous in the Philippine form, and remains about the same throughout the life of the female. The upward curve of the distal part of the rostrum in the males does not seem to differ from that in the females, except in the large males (those with the enormously developed chelipeds), where the tip scarcely bends upward at all. The degree of arching over the eye is slightly greater in the old than in the young males.

The dental formula is very variable. An examination of the specimens in the collection shows the formula for the males (100 to 320 millimeters) to be $\frac{11, 12, 13, 14}{8, 9, 10, 11}$. In one exceptional case 12 teeth are found on the lower border, 2 of which, however, are situated well up under the arch over the eye. The smallest male (100 millimeters) has the formula $\frac{12}{8}$, while the largest male (320 millimeters) has $\frac{11}{9}$. In the females (115 to 250 millimeters) the formula is $\frac{11, 12, 13}{8, 9, 10}$. Those of the smallest (115 millimeters) and largest (about 250 millimeters) are $\frac{12}{10}$ and $\frac{12}{9}$, respectively. It appears that the number of teeth in the males is somewhat greater than in the females, but there

is no evidence that the number of the teeth increases with the age. In the large majority of both males and females the formula is $\frac{12 \text{ to } 13}{9 \text{ to } 10}$. The dorsal border of the rostrum in young males and females may be divided into a proximal two-thirds armed with 9 or 10 teeth and a distal one-third usually unarmed, except near the tip where there may be 2 or 3 teeth. (A similar condition has been described by von Martens [16] for *Palaemon carcinus* from Luzon.) The bases of the first and second teeth and part of the base of the third tooth lie back of the orbit. These teeth are more widely separated from one another than the following 6 or 7 teeth, and also the ninth and tenth teeth are separated somewhat more from the teeth directly back of them. The unarmed portion of the distal one-third has a length of 9 or 10 millimeters in specimens measuring 115 millimeters in body length, and beyond this lie the 2 or 3 rather widely separated teeth of the tip region. The usual 9 or 10 teeth of the ventral border are more widely separated toward the tip than at the proximal end. In middle-aged males and females the arrangement of the teeth is similar, but the unarmed space is, relatively, slightly shorter. The bases of the first, second, and third teeth of the upper border in the largest males lie back of the orbit, and the unarmed space is proportionately shorter than in the middle-aged males and females.

The following facts concerning the rostrum of *Palaemon carcinus* found in the Philippines seem clear from the study of our collection:

1. The rostrum increases in length as the body length becomes greater.
2. In young males and females the rostrum extends much beyond the antennal scale.
3. As the males and females grow older, the rostrum extends less beyond the antennal scale; this is, especially, the case in males.
4. In old males (250 to 320 millimeters), those with the enormously developed chelipeds, the rostrum fails to reach the antennal scale by a considerable distance.
5. The number of the teeth does not vary with the length of the rostrum, with the length of the body, nor with the age of the individual.

Relative position of first antenna and rostrum.—As in other palaemons, the peduncle of the first antenna fails to reach the antennal scale. While it increases in length as the animal grows older, it retains about the same relative proportions; that is, the peduncle extends forward over about three-fifths of the

[16] *Ibid.* (1868), 5, 35.

antennal scale of the second antenna. A glance at Table I shows that the tip of the peduncle varies in position with reference to the teeth on the lower border of the rostrum. In the smallest males and females it extends to the third or fourth tooth, while in the largest males with the small legs and in the largest females it extends to the fifth, sixth, or seventh tooth. In the large males with the enormously developed chelipeds the tip of the peduncle reaches almost to the end of the rostrum.

First pair of legs.—The length of the first pair of legs with reference to the length of the antennal scale does not seem to vary much. In young males and females usually the propodus of the first leg extends beyond the tip of the antennal scale, while in the largest males the propodus and as much as one-fourth or one-half of the carpus may be seen beyond the tip of the scale.

Chelipeds.—The chelipeds are much shorter in young males and females than the length of the body from the tip of the rostrum to the tip of the telson. Even in the adult and largest females these fail to equal the body length. Also, males under 240 millimeters in length with weakly developed legs have the chelipeds shorter than the body, but males over 250 millimeters in length have the chelipeds longer than the body. The chelipeds of the largest male in our collection (body length, 320 millimeters) measure 486 millimeters (ischium, merus, carpus, and propodus), and they extend with one-half of the merus beyond the tip of the antennal scale. As a rule, in young males and females the palm and fingers are nearly of the same length, but as the animals grow older the palm increases in length more rapidly than the fingers, so that the proportion may be as much as 1 : 1.43. In Table I it will be seen that the smallest male in the collection shows a proportion of 1 : 1.33. Only one cheliped is present in this case, and I believe the proportion is unusual. A similar proportional increase in the length of the palm is seen in the female, but it is not so striking. In all of our specimens, male and female, the carpus is shorter than the propodus. The difference is not so great in the young specimens, and I think it probable that younger specimens than we have might show the carpus to be longer than the propodus, a condition which de Man has observed in the young of the Indian form.

The fingers of young specimens (100 millimeters) show no toothing, but at 115 to 120 millimeters the teeth begin to make their appearance. The mobile finger is armed along its cutting edge with 2 acute teeth. The distal tooth is situated at a point one-third of the distance or a little more from the articulation

to the tip of the finger, and it is flattened laterally.[17] It measures 2.5 by 2 millimeters at the base in our largest specimens, and is 2.5 millimeters high. The proximal tooth is found about midway between the distal tooth and the articulation of the finger. It is flattened laterally, and in the largest males is smaller than, but of the same shape as, the distal tooth. In old males with the enormously developed chelipeds there are 4 teeth present on the immobile finger. The distal one, which is conical in shape (3 millimeters at the base and 3 millimeters in height), is the largest, and is situated 4 or 5 millimeters anterior to the proximal tooth of the mobile finger. Also, in younger males and females this tooth is found in front of the proximal tooth of the mobile finger but much closer to it. The next tooth, which is much smaller and less acute than any so far described, touches the proximal tooth of the mobile finger on its posterior side when the fingers are closed. Directly back of this tooth and almost continuous with it is the third tooth, which is still smaller. The fourth tooth is continuous with the third, and might be considered as a smaller cusp of the third tooth. In young males and females and even sometimes in the very old males the fourth tooth is not distinguishable, but is represented by a short raised piece of the cutting edge. In the oldest male in our collection (320 millimeters) there is an indication of a fifth or sixth tooth, which might become more distinct in larger specimens. While the toothing in general is much like that of *Palaemon carcinus* F. of India as described and figured by Henderson and Matthai,[18] the teeth in our form seem to be somewhat more robust. A felt-like coat of hair is present on the mobile finger of both males and females, except when they are very young. Specimens in our collection from 100 to 115 millimeters long show no signs of this hair. As a rule, only the proximal one-half of the finger is coated in the young measuring from 115 to 140 millimeters, but as the animals grow older the coat extends gradually until it covers all but the distal one-fourth. Herbst's [19] figure of *Pa-*

[17] In most living palaemons the chelipeds are held so that the immobile finger lies more nearly in a dorsal position and the mobile finger more nearly in a ventral position, but sometimes in preserved specimens the cheliped becomes twisted so that the fingers lie in a horizontal plane. In this paper the immobile finger will be considered as dorsal in position with reference to the mobile finger, and in the case of *P. carcinus* the long rows of large spines will mark the dorsal and ventral surfaces of the merus and carpus. The ischium remains in about the same position after preservation.

[18] *Rec. Indian Mus.* (1910), 5, 281, Pl. XV, fig. 1a.

[19] Versuch einer Naturgeschichte der Krabben und Krebse (1796), 2, Tab. XXVIII, fig. 1.

laemon carcinus shows a condition similar to that found in our form, except that the coating of hair extends a little farther toward the tip. In the figure shown by Henderson and Matthai, however, the pubescence extends to the tip of the finger. The tips of both fingers curve inward in specimens of all ages, and overlap when the fingers are closed. In young specimens with a body length of about 150 millimeters or less, the fingers when closed lie close together throughout their extent, but larger individuals have the fingers gaping. In old males the immobile finger, which is curved less sharply at the tip than the mobile finger, extends beyond the latter. The immobile finger of the largest male presents 13 or 14 indistinct longitudinal rows of small spines. Several of these rows, especially the one along the cutting edge, are made up of larger spines than those of the other rows. Near the tip of the finger the cutting edge disappears and the number of rows of spines is reduced. Spines are absent along the cutting edge and the region covered by the felt of the mobile finger, but a few spines are to be seen along the incurved tip. The cutting edge disappears near the tip. In young males and females the fingers are spineless.

The palm of the largest male in our collection measures 122 millimeters in length. It is flattened laterally at the distal one-half, measuring 13 by 16 millimeters, but at the proximal one-half it becomes almost cylindrical in cross section, measuring about 15 millimeters in diameter. It presents about 18 longitudinal rows of spines, which in general are larger than those on the fingers, and the rows on the inner surface are made up of spines which are larger than those of the rows on the outer surface. An average-sized spine of the larger kind measures 2 millimeters in length. The palm is marked on each lateral surface by a longitudinal groove, and each of these grooves is continued, except with a break at the joint, into a "linear space" on the outer and inner surfaces, respectively, of the carpus which is similar to that described by Hoffman, von Martens, and Coutière. The shape of the palm in all younger males and females is the same as that of the old males. Males and females of middle age show the characteristic rows of spines, but these are not so conspicuous, and in young males and females they are only visible with a lens. The grooves can be seen in specimens of all ages and both sexes represented in our collection.

The carpus in our largest male equals the palm in length, but probably in larger specimens it is shorter. In the oldest females the palm is shorter than the carpus, and the same is true of young individuals of both sexes. Table I shows that the

palm grows faster than the carpus as the individuals increase in size, a fact which has been pointed out by several authors. The carpus of the largest male in the collection measures 122 millimeters in length, and is cylindrical in cross section throughout practically the whole extent. Near its distal end the diameter is 17 millimeters, while at a point near the proximal end it measures 13 millimeters. Eleven indistinct longitudinal rows of small spines are present on the outer surface, and these are separated from 3 indistinct rows of medium-sized spines on the inner surface by a dorsal and a ventral longitudinal row of blunt and conspicuous spines. One of the largest of these spines is 4 millimeters in length. The 2 linear spaces mentioned above are very distinct, and lie on the dorsolateral and ventrolateral regions of the outer surface. All younger males and females show the carpus to be of the same shape as that of the large male. In the youngest individuals (100 to 115 millimeters) minute spinules may be seen with a lens, and slightly older specimens show the beginnings of the 2 rows of largest spines. The "linear spaces" can hardly be made out until the spines show clearly to the naked eye.

The merus, which retains about the same relative proportion in length to the carpus throughout life, is cylindrical anteriorly in the largest male, and has a length of 100 millimeters. It increases gradually in size, passing from the proximal end forward, and near the distal end suddenly decreases in diameter thus giving the impression of a swelling. About 13 millimeters from its proximal end it measures 13 millimeters, and at the thickest part of the distal end it measures 18 millimeters in diameter. The merus at its articulation with the ischium is much flattened dorsoventrally, so as to correspond to the distal end of the ischium. The dorsal and ventral longitudinal rows of large spines, which are very conspicuous on the carpus, are even more so on the merus, one of the largest spines measuring 5 millimeters in height. There are 6 indistinct longitudinal rows of small spines on the outer surface and 5 indistinct rows of medium-sized spines on the inner surface. The more dorsal "linear space" of the carpus is continued on the merus, while the more ventral one is absent or at least not clearly marked. The description of the character of the surface of the carpus in younger males and females applies to that of the merus in specimens of the same age.

The ischium (57 millimeters in length) in the largest male is greatly flattened dorsoventrally, and increases in size toward the distal end. On the dorsal and ventral surfaces there are 2 lon-

gitudinal grooves, one of which is deep. These divide the surface into 3 regions—2 lateral and 1 median. Distally the median region of the dorsal surface is highly convex and armed with several stout spines, while the rest of this surface is spineless. The median region of the ventral surface is smooth. The externolateral region of the ventral surface presents a longitudinal row of fairly stout spines and 2 rows of smaller spines; the internolateral region of the same surface is armed with 2 longitudinal rows of fairly stout spines; the externolateral region of the dorsal surface presents 2 rows of medium-sized spines; and the internolateral region presents 1 row of fairly stout spines. In younger males and females the more shallow groove mentioned above is absent, so that the same regions cannot be distinguished. The armature and shape remain about the same, except that the spines diminish in size until in the smallest specimens no spines are visible. The ischium grows slower (Table I) than the merus and carpus, a fact which has been noted in the publications of other authors on palaemons in general.

Third, fourth, and fifth legs.—The third pair of legs in specimen 2 is absent. The tip of the fourth leg and the dactylus of the fifth leg extend beyond the tip of the antennal scale. The diameter of the propodus of the fifth leg in the middle is 0.75 millimeter, and the length is 15 millimeters. In specimen 9 the tips of the dactyli of the third, fourth, and fifth legs extend slightly beyond the tip of the antennal scale, and the measurements for the propodus of the fifth leg are 1.25 by 25 millimeters. The fifth leg only of specimen 16 is present, and 7 millimeters of its propodus extend beyond the scale. It measures 4 millimeters in diameter at its middle, and is 61 millimeters long.

Telson.—The telson of the local form agrees with the descriptions and figures which have been published for *Palaemon carcinus*. The innermost pair of laterotermínal spines on each side of the tip is the largest and best developed. The tip of the telson is acute, and does not extend as far as the posterior border of the uropods.

Character of surface.—As in many other palaemons, the character of the surface of the carapace and abdomen differs with the age. The carapace and abdomen of males and females from 100 to 190 millimeters in length are strikingly smooth to the touch and under magnification show no spines. The third, fourth, and fifth pairs of legs are beset with rows of minute yellowish spinules, especially along their distal two-thirds, but the first pair of legs are devoid of spines of any sort. Males and

females, 190 to 240 millimeters long, show a similar condition to that found in the smaller individuals, except that the merus and ischium of the first pair of legs are armed with spinules and the spinules of the third, fourth, and fifth legs are larger. The surface of the carapace in large males (240 or 250 to 320 millimeters, with long chelipeds) is rough to the touch and beset with spinules, except along the extreme posterior border. The spinules of the dorsal and anterolateral regions are larger than those of other parts. These spinules, which are usually acute, point forward, and average about 0.5 millimeter in length. Most of the dorsal and lateral surfaces of the abdominal segments and the dorsal surface of the inner ramus of each uropod have a growth of fine spinules, causing them to feel rough to the touch. The first, third, fourth, and fifth legs are armed like younger specimens, but the spines are larger.

Eggs.—The eggs of the local form of *Palaemon carcinus* measure from 0.5 by 0.5 to 0.5 by 0.66 millimeter.

Color of living specimens.—The local form of *Palaemon carcinus* varies in color with the age, but the color is fairly constant for any one age. The following color notes are taken from living specimens. The carapace of females (115 to 190 millimeters) is greenish gray, but is marked with brown, gray, or cream-colored streaks running longitudinally. The terga and pleura of the abdomen have a general color similar to that of the carapace, and are marked with rather irregular but more or less parallel streaks of brown, gray, or cream, which make a somewhat definite pattern. In the region of the hinge of each of the abdominal somites is an orange-colored patch; these patches are especially evident on the fourth, fifth, and sixth somites. The ventral and lateral edges of the first 3 abdominal somites show a cream-colored band, while the ventral edges of the fourth and fifth somites have a similar but narrower band. A cream-colored band is also present along the edges of the rami and the outer edge of the basipodite of the swimmerets. The chelipeds are blue or lavender in color, but where the segments join there is an orange-colored patch. The first and second antennæ are blue, in part at least, and the internal flagellum of the first antenna is a conspicuous blue. The rostrum is strikingly marked by the vermilion color of its lateral longitudinal ridge. The colors practically all disappear, sooner or later, when the specimens are preserved, leaving the animals yellow in color. Living males (100 to 190 millimeters) have a color which is similar to that of the young females, except that the cream-colored band is absent on the pleura of the abdomen.

A faint cream-colored band is present on the external rami of the swimmerets. As the males and females (190 to 240 or 250 millimeters) grow larger and the chelipeds become longer, the general color becomes a darker blue and the brown, gray, or cream-colored lines on the carapace and abdominal somites and the cream-colored bands on the pleura become much less distinct. The color of other parts still persists, but becomes somewhat darker. In old males (240 or 250 to 320 millimeters) with the enormously long chelipeds the color is much less brilliant than in the younger specimens. The dorsal region of the carapace and abdomen is brownish green, and the lateral regions are light green or brown. The brown, gray, or cream-colored markings and bands so characteristic of smaller individuals disappear almost entirely, while the orange-colored spots on the abdomen and at the articulations of the segments of the chelipeds, the vermilion color of the ridge on the rostrum, and the conspicuous blue of the first and second antennæ usually persist to some extent, but become noticeably darker. The chelipeds appear at first sight a dirty black, but on closer examination they are seen to be a very dark, dirty blue, except in the proximal region where they are greenish blue. The third, fourth, and fifth legs are bluish green in color. The ventral border of the pleura of the sixth abdominal segment shows a distinct orange-colored band.

A comparison of the color of the local *Palaemon carcinus* with descriptions and color drawings of *Palaemon carcinus* from India shows, that while there is a general similarity there are some striking differences. The blue color of the cephalothorax and abdomen is absent, and in its place there are cream-colored bands and other markings. The latter may be present in young specimens of the Indian form. The first and second antennæ, so far as I have been able to make out from colored drawings and descriptions, are not blue like those of our local form, and it is of interest to note that in no other palaemon in the Philippines with which I am familiar are the antennæ colored in the same way as those of the local form of *P. carcinus*. Finally, the striking changes in color as we pass from the younger specimens to the older ones, if occurring in *Palaemon carcinus* of India, do not seem to have been recorded.

Old and young males.—While specialists on the genus *Palaemon* are familiar with the fact that the old males in some species look very different from the young males and while it seems probable that the same is true for all species of *Palaemon*, it is difficult to convince one who is not a zoölogist or even a zoölogist

who is not familiar with palaemons that the old males are of the same species as the young males and females. The following are my reasons for considering the large brownish palaemon, which is seen in our museums and sometimes in our markets and which has the extremely long and thick chelipeds, as the same species (*P. carcinus*) as the beautifully colored young males and females with short weak chelipeds:

1. Both the first and second antennæ show the deep peacock blue color, which is found in no other species in our collection.
2. If we assume that the large brown form with the enormous chelipeds is a different species from the smaller brightly colored males and females, then we have to account for the facts that all of the large brown forms are males, that no females have been found corresponding to them in size and shape, and that the fishermen have never caught any females like them.
3. The number of teeth on the dorsal and ventral borders of the rostrum is approximately the same in both.
4. While the rostrum is distinctly shorter proportionately in the large brown form, a gradual reduction in the relative length of the rostrum can be traced if we place both kinds together in a series arranged according to increasing body length.
5. In living specimens a series shows how the brilliant color of the young gradually grades into the dull brown of the old form.
6. Both kinds have the coat of felted hair on the mobile finger.
7. The chelipeds are blue in both forms, but very dark blue in the large form.

"Mâles féminisés."—It is not possible to determine whether or not our collection of *P. carcinus* contains what Coutière [20] speaks of as "mâles féminisés," although all the males, except the oldest ones, show the female characteristics; that is, the chelipeds are weak and short. Plate I, figs. 1*e* and 1*f*, shows how little the chelipeds of the full-grown female and the chelipeds of the young male differ from one another. As a matter of fact, our collection does not contain any young male which has taken on the characteristics of the old males, with the possible exception of the specimen (240 millimeters) noted in Table I. These males are more numerous in our collection of *Palaemon philippinensis* sp. nov., which is described on page 340.

The enormous increase in the size of the chelipeds and the change in shape of the fingers in the old males of *P. carcinus*, *P. lar*, *P. jamaicensis*, and other species are phenomena which cannot fail to stimulate the mind of the zoölogist. Ortmann [21] thinks that we have every reason for believing that the beautiful

[20] *Ann. Sci. Nat., Zool.* (1900), 11, 269.

[21] Bronn's Klassen und Ordnungen des Thier-Reichs (1901), 5, 1242.

chelipeds of the male *Palaemon carcinus* are sexual adornments. In our local form of *Palaemon carcinus* the chelipeds of young males, young females, and mature females are blue or lavender, while the chelipeds of the old males are very dark, inconspicuous blue. I can readily believe that the blue color is an adornment, but I can hardly believe that it is attractive to the females, even if we assume that they have color sense, as these palaemons live in water which is far from clear. A study of the habits of the palaemons may throw some light on the meaning of these large chelipeds.

Localities.—We have in our collection 41 males and 21 females which were collected from Pasig River, San Juan River (a tributary of Pasig River), and Laguna de Bay, the source of Pasig River. All of these bodies of water are in the neighborhood of Manila, Luzon. Since the above was written, several large specimens have been added to the collection by A. L. Day, who collected them in Naujan Lake near Calapan, Mindoro.

Palaemon philippinensis sp. nov. Plate II, figs. 2 and 2*a-m*.

This species presents much variation in the shape and general appearance of the rostrum. The proportion of the carpus to the merus of the chelipeds is not constant, the carpus increasing in length faster than the merus as the animal grows longer. Another characteristic of this species (possibly of all species of *Palaemon*) is the occurrence of dimorphic males; that is, some of the males of medium size have chelipeds of about the same length and shape ("mâles féminisés" of Coutière)[22] as those of the females of the same size, and other males of small or medium size, but usually covered with brownish sediment, have the characteristics of the largest and undoubtedly mature males; namely, enormously long chelipeds with well-armed and gaping fingers (young mature males). In our collection the "mâles féminisés" far outnumber the other males (Table II).

[22] *Ann. Sci. Nat., Zool.* (1900), 11, 269. In the present paper the following terms are used to distinguish between different forms of males: "Young males," "mâles féminisés," "young mature males," and "old mature males." The distinction between the different forms is not always clearly defined, but the terms are used for convenience in description and for the purpose of indicating my attitude in reference to Coutière's statement that dimorphic males exist among palaemons. It should be understood, however, that I have no proof that the "mâles féminisés" are nonbreeding individuals or that the "young mature males" are breeding individuals. The former term is used for medium-sized male specimens that have chelipeds like those of the females and the latter term is employed for such small or medium-sized males as have chelipeds like those of the largest males.

Palaemon philippinensis seems to be most nearly related to *P. nipponensis* de Haan,[23] differing from this species in size, in the absence of the rather thick coating of hairs on the fingers, and in the presence of distinct tubercles along the sides of the cutting edge. The tubercles (absent in young males, in most "mâles féminisés," and in all females but the largest specimen) remind one of *P. elegans* de Man [24] and *P. rudis* Heller,[25] but in *Palaemon philippinensis* the tubercles are found on both sides of the cutting edge of the mobile finger and only on one side, the inner, of the cutting edge of the immobile finger.

Two other striking characteristics of this species are the variability in the shape of the rostrum, reminding one of *P. weberi* de Man, and the variability in proportion between the lengths of the carpus and merus, which also seems to be characteristic of *P. ritsemae* de Man [26] and *P. rudis* Heller. These variations, together with the occurrence in the collection of both forms of the male, would have aroused a doubt in my mind as to the specimens being of one species if I had not seen them all shortly after they were taken from the water, when the living color was still retained and when they showed a characteristic T-shaped pigment mark and certain obliquely placed pigment marks on each side of the carapace, which are found in no other species in our collection. (See discussion on the color of *P. philippinensis*.)

The following is a description of the largest male specimen in the collection (one from San Juan River near Manila), after which follows a comparative description of specimens differing in age and sex:

This male (Table II, specimen 31) (Plate II, figs. 2, 2*a*, 2*b*, and 2*c*) measures 144 millimeters in length. The rostrum fails to reach the tip of the antennal scale. The dorsal border is conspicuously convex over the eye, the ventral border curves upward moderately, but the tip is not directed upward. The ridge along the side of the rostrum divides the surface of the latter into an upper wide and a lower narrow area. Along the dorsal border are 12 teeth, the first, second, and third of which are situated on the carapace These are separated by wider intervals than those immediately following. The ninth and eleventh teeth are also farther apart than those immediately

[23] Fauna Japonica. Siebold (1833), 1, 171.

[24] Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien (1892), 2, 440.

[25] Reise der Österreichischen Frigatte Novara (1868), 2, 115.

[26] *Zool. Jahrb., Systematik* (1897), 9, 774.

TABLE II.—*Palaemon philippinensis sp. nov.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Carapace length (posterior face of eye to posterior border of carapace).	Rostral formula.	First antenna (position of peduncle with reference to rostral teeth).	First pair of legs (extension beyond antennal scale).	Extension of chelipeds beyond antennal scale.
		mm.	*mm.*				
1	♂	33.5	6.5	13/5	To third tooth on ventral border	Tip of propodus extends slightly beyond antennal scale.	Absent.
1a	♂	39.5	8.0	11/3	Almost to third tooth on ventral border	Tip of propodus	Two-thirds of carpus.
2	♂	90.0	22.0	11/4	To fourth tooth on ventral border	A little of carpus	Almost whole of carpus.
3	♂	92.5	23.5	11/4	About 1.5 mm. beyond fourth tooth	One-third of carpus	One-fourth of merus.
4	♂	a103.5	27.5	10/3–11/3	About 1.5 mm. beyond third tooth	Almost one-half of carpus	Almost one-half of merus.
5	♂	104.0	27.0	12/3	1.5 mm. beyond third tooth	Little of carpus	All of carpus.
6	♂	104.5	29.5	12/4	1.5 mm. beyond fourth tooth	About one-half of carpus	Almost one-half of merus.
7	♂	108.0	29.0	12/4	do	Little of carpus	Not quite all of carpus.
8	♂	108.5	29.0	12/4	About 1.5 mm. beyond fourth tooth	About one-half of carpus	All of carpus.
9	♂	109.5	30.5	11/4	Almost to tip of rostrum	Little of carpus	Not quite all of carpus.
10	♂	110.0	29.0	13/5	Extends to fifth tooth	About one-fourth of carpus	All of carpus.
11	♂	110.5	30.0	12/5–13/5	About 1.5 mm. beyond fourth tooth	One-third of carpus	One-half of merus.
12	♂	111.0	30.0	13/4	Little beyond fourth tooth	Little of carpus	All of carpus.
13	♂	111.5	33.0	11/2	About to tip of rostrum	One-third of carpus	Little more than one-half merus.
14	♂	112.5	30.0	13/4	About 1.5 mm. beyond fourth tooth	Almost one-third of carpus	All of carpus.
15	♂	113.0	31.5	12/4	do	About one-half of carpus	Almost one-half of merus.
16	♂	113.0	30.0	12/4	1.5 mm. beyond fourth tooth	Little of carpus	Whole of carpus.
17	♂	113.0	31.0	12/4	do	One-fourth of carpus	Not quite all of carpus.
18	♂	114.0	30.0	13/5	To tip of fourth tooth	A little of carpus	All of carpus.
19	♂	114.0	30.0	12/3	About 2 mm. beyond fourth tooth	Almost one-sixth of carpus	Do.
20	♂	115.0	32.0	11/4	Almost reaches tip of rostrum	One-third of carpus	Do.
21	♂	117.0	31.0	12/4	1.5 mm. beyond fourth tooth	Little over one-fourth of carpus	Not quiet all of carpus.

22	♂	118.0	32.0	13/4	About 1.5 mm. beyond fourth tooth	Almost one-half of carpus	All of carpus.
23	♂	[a]119.0	34.0	12/4	2 mm. beyond fourth tooth	One-third of carpus	One-half merus.
24	♂	121.5	33.0	12/4	Slightly beyond fourth tooth	One-fourth of carpus	Little of merus.
25	♂	124.0	33.5	13/4	One-half way between tip of rostrum and fourth tooth.	One-third of carpus	Whole of carpus.
26	♂	125.0	34.0	12/4	Almost to tip of rostrum	do	One-half of merus.
27	♂	125.5	36.0	13/5	Between fourth and fifth teeth	do	One-third of merus.
28	♂	[b]129.0	35.5	13/4	(?)	One-half of carpus	About two-fifths of merus.
29	♂	137.0	38.5	12/4	Almost to tip of rostrum	do	Do.
30	♂	137.5	37.0	12/4	do	Absent	One-half of merus.
31	♂	144.0	40.5	12/3	do	One-third of carpus	Little more than one-half of merus.
32	♀	47.0	10.0	12/4	Peduncle extends slightly beyond third tooth of ventral border.	About two-thirds of propodus	Two-thirds of carpus.
33	♀	69.0	15.0	12/3	do	Whole of propodus	Three-fourths of carpus.
34	♀	[c]71.5	18.0	12/4	Almost to fourth tooth	Propodus	Little more than one-half of carpus.
35	♀	[d]86.0	20.0	13/4	To fourth tooth	do	Two-thirds of carpus.
36	♀	[c]93.0	25.0	18/3	Almost to tip of rostrum	Little of carpus	Three-fourths of carpus.
37	♀	97.0	42.5	12/4	Tip of peduncle even with fourth tooth of ventral border.	One-fourth of carpus	Do.
38	♀	99.5	26.0	13/4	Peduncle extends slightly beyond fourth tooth.	A little of carpus	Almost whole of carpus.
39	♀	118.0	31.0	11/4	One-half way between tip of rostrum and fourth tooth.	One-half of carpus	All of carpus.

[a] Tip of rostrum broken.
[b] Body length and rostral formula estimated. Rostrum broken.
[c] Eggs recently shed.
[d] With eggs.

TABLE II.—*Palaemon philippinensis sp. nov*—Continued.

No.	Sex.	Chelipeds.									
		Length of—						Total length beginning with ischium.	Gaping of fingers.	Tubercles on fingers.	Proportion of merus to carpus.
		Propodus.	Fingers.	Palm.	Carpus.	Merus.	Ischium.				
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			
1	♂										
1a	♂	10.0	4.5	5.5	8.0	6.0	5.5	29.5	No gaping	Absent	1.33
2	♂	24.0	11.0	13.0	19.0	12.0	11.0	66.0	do	do	1.58
3	♂	39.0	15.5	23.5	31.0	19.0	14.0	103.0	Slight gaping	Present	1.63
4	♂	58.5	22.0	36.5	45.0	25.5	16.5	145.5	do	do	1.76
5	♂	39.0	17.0	22.0	28.0	17.5	14.5	99.0	No gaping	Absent	1.60
6	♂	49.5	18.5	31.0	41.0	25.0	19.5	135.0	Slight gaping	Present	1.64
7	♂	39.0	16.5	22.5	26.5	17.0	14.5	97.0	No gaping	Few present	1.55
8	♂	37.5	15.0	22.5	29.0	19.0	15.0	100.5	do	do	1.52
9	♂	40.0	17.5	22.5	28.5	18.0	15.0	101.5	do	do	1.55
10	♂	38.0	16.0	22.0	28.0	18.0	16.0	100.0	do	do	1.55
11	♂	67.0	27.5	39.5	52.0	29.0	22.0	170.0	Wide gape	Present	1.78
12	♂	41.0	17.0	24.0	31.0	19.5	15.5	107.0	No gape	do	1.58
13	♂	84.5	32.5	52.0	62.0	33.5	21.5	201.5	Gape very wide	do	1.85
14	♂	41.5	17.5	24.0	30.5	18.5	16.0	106.5	No gape	do	1.64
15	♂	60.5	24.5	36.0	50.0	29.0	18.5	158.0	Slight gape	do	1.72
16	♂	44.5	17.5	27.0	32.5	20.0	15.0	112.0	No gape	do	1.62
17	♂	43.0	18.0	25.0	30.0	19.0	15.5	107.5	do	do	1.57
18	♂	39.0	16.0	23.0	28.0	17.0	15.0	99.0	do	do	1.64
19	♂	42.0	17.0	25.0	32.5	19.0	16.0	109.5	do	do	1.71
20	♂	41.0	15.0	26.0	33.0	19.0	16.0	109.0	do	do	1.73
21	♂	38.5	15.0	23.5	28.0	19.0	15.0	100.5	do	do	1.46
22	♂	44.0	18.0	26.0	34.5	20.0	17.0	115.0	do	do	1.72

23	♂	76.5	29.5	47.0	63.5	34.5	22.0	196.5	Gape wide	do	1.84
24	♂	50.5	20.5	30.0	36.5	22.0	16.5	125.5	Slight gape	do	1.66
25	♂	43.5	18.0	25.5	31.5	20.5	17.0	112.5	No gape	do	1.53
26	♂	82.0	27.0	55.0	67.0	38.0	24.0	211.0	Wide gape	do	1.76
27	♂	69.5	27.0	42.5	53.5	31.0	20.0	174.0	do	do	1.72
28	♂	69.5	26.0	43.5	51.0	30.0	20.5	171.0	Considerable gape	do	1.70
29	♂	69.5	25.5	44.0	50.5	31.5	20.5	172.0	do	do	1.60
30	♂	108.0	37.0	71.0	81.5	42.0	26.0	257.0	Very wide gape	do	1.94
31	♂	108.5	38.5	70.0	84.0	45.5	28.5	266.5	do	do	1.84
32	♀	[a]11.0	5.0	6.0	9.5	6.0	5.5	32.0	No gape	Absent	1.58
33	♀	18.0	8.0	10.0	14.0	9.5	9.0	50.5	do	do	1.47
34	♀	18.0	8.0	10.0	13.5	9.0	9.0	49.5	do	do	1.50
35	♀	23.5	10.5	13.0	17.0	12.0	11.0	63.5	do	do	1.41
36	♀	29.0	13.0	16.0	21.0	14.0	13.0	77.0	do	do	1.50
37	♀	26.0	12.0	14.0	19.0	14.0	12.0	71.0	do	do	1.35
38	♀	30.5	12.5	18.0	23.0	16.0	12.5	82.0	do	do	1.43
39	♀	41.5	18.0	23.5	28.5	19.0	16.5	105.5	Very slight gape	Present	1.50

[a] Left cheliped only.

posterior to them. On the lower border are 3 teeth, the distal one of which lies some distance back of the tip. The peduncle of the first antenna reaches almost to the tip of the rostrum. One-third of the carpus of the fully extended first pair of legs extends beyond the antennal scale.

The left cheliped, which is a little longer than the right (not true of all specimens), measures 266.5 millimeters, being a little less than twice as long as the body. The immobile finger extends farther forward than the mobile finger, and is not curved inward so sharply. The fingers are a little more than one-half as long as the palm (1 : 1.81), and in this specimen they gape; that is, when their tips meet, there is an open space between the fingers. Of the 2 teeth situated near the proximal end of the mobile finger, the more distal one, which is subacute and flattened laterally, is 2 millimeters high and 2 millimeters wide at the base. The more proximal one is smaller, less acute, and is flattened laterally. It measures 1.5 millimeters in height and 1 millimeter at the base. The cutting edge of the mobile finger is seen with difficulty, being simply a very slightly raised ridge. On each side of it is a row of 12 plainly visible tubercles, which do not extend to the tip. There is no thick coating of hair as in *Palaemon nipponensis*. On the immobile finger, which is also without the thick coating of hair, is a large subacute tooth, which is situated a little posterior to the distal tooth of the mobile finger. It is conical in shape, measuring 2.5 millimeters in height and 2 millimeters in width at the base. Back of this tooth may be seen a series of 4 closely set teeth. The most anterior of the 4, which is the largest, is on a level with the more proximal tooth of the mobile finger. The second, third, and fourth decrease gradually in size, and the last 2 are incompletely separated. A series of 8 or 9 tubercles, similar to those on the mobile finger, is situated along the inner side of the very inconspicuous cutting edge. The palm, which is almost cylindrical in cross section, is flattened slightly laterally. It is of about the same size throughout its extent, and is shorter than the carpus. The cylindrical carpus, which reaches its greatest diameter (9 millimeters) some little distance back of the distal end, is much shorter than the chela, while the slightly curved merus, which is almost cylindrical near its distal end and decidedly flattened near its proximal end, is much shorter than the carpus, showing a ratio of 1:1.5. The much flattened ischium has its dorsal and ventral surfaces divided into 2 regions by a longitudinal groove. The lengths, in millimeters, of the parts of the cheliped

just described are as follows: Propodus, 105.5; fingers, 38.5; palm, 70; carpus, 84; merus, 45.5; ischium, 28.5.

The telson of this specimen ends in a subacute spine. The externolateral spines are slightly less than 1 millimeter in length, while the internolateral spines, which extend with a little less than one-half their length beyond the tip of the telson, measure about 1.5 millimeters in length. (See description of telson in smaller specimens.)

Patches of very obtuse spines are present on the anterior surface of the carapace. Similar spines are seen on the ventral and lateral parts of the pleura, on the dorsal surface of the sixth somite and the telson, and on exposed parts of the dorsal and ventral surfaces of the uropods. These spines are especially numerous on the last three structures named.

The ischium of the first pair of legs and the 5 distal segments of the third, fourth, and fifth pairs of legs are clothed with acute spinules. Eight or 9 indistinct longitudinal rows of blunt, small spines (much smaller than the tubercles) are seen on the mobile finger of the chelipeds, and the immobile finger bears 7 or 8 rows of similar spines. The palm is armed with 26 or 27 more distinct longitudinal rows, made up of larger and more acute spines than those of the palm, the spines of the ventral and dorsal surface being the largest. On the carpus are 17 or 18 longitudinal rows of spines, similar to those of the palm. A dorsal "linear space" is evident, and a ventral "linear space" is very conspicuous. It will be seen that these spaces are not situated on the lateral surface as in the local *P. carcinus*. The merus presents about the same number of longitudinal rows made up of spines similar to those of the carpus, and the dorsal and ventral "linear spaces" can still be seen, although the former is not very clear. There are 14 or 15 rows of acute spines on the ischium, the largest ones being situated on the dorsal, ventral, and internolateral surfaces.

Rostrum and antennal scale.—The 8 female specimens in our collection, when arranged according to increasing body length, show a gradual reduction in the length of rostrum relative to the length of the antennal scale. In a specimen 47 millimeters long the rostrum extends slightly beyond the tip of the antennal scale; in others, 69, 71.5, and 86 millimeters long, they are equal; in specimens 93, 97, 99.5, and 118 millimeters long the rostrum fails to reach the tip of the antennal scale by 2.5, 1, 3, and 3 millimeters, respectively. The rostrum extends 1 millimeter beyond the tip of the antennal scale in the smallest male specimen

(33.5 millimeters); in specimens from 90 to 96.5 millimeters long the tip of the rostrum barely reaches the tip of the antennal scale; in those from 96.5 to about 124 millimeters long the rostrum usually fails to reach the tip of the antennal scale by from 1 to 3 millimeters; and in specimens from 124 to 144 millimeters long this distance usually increases to from 4 to 6 millimeters. The specimen (111.5 millimeters) indicated in Table II is a male which has assumed adult male characters (young mature male), although its body is still only of medium length. It is covered with a dirty brown sediment, and its chelipeds are enormously developed relative to the body length. The rostrum fails to reach the antennal scale by 7.5 millimeters. The chelipeds, although much shorter than those of the specimen 144 millimeters long (Table II), are almost perfect miniatures, showing practically the same proportions. While the decrease in the relative length of the rostrum with reference to the antennal scale is not so regular with increasing size as in the local form of *Palaemon carcinus*, it is, nevertheless, plainly apparent.

Curvature and dental formula of rostrum.—Specimens of different ages show such a remarkable difference in the shape of the rostrum, that if I had not seen all of my specimens when alive I should hesitate to consider them as belonging to the same species. In this respect *P. philippinensis* reminds one of the variable form of the rostrum in *P. weberi* de Man [27] and *P. dispar* von Martens.[28] Certain characteristic markings mentioned under the section devoted to the color of the living individuals and not found in any other species in our collection were present in all. The youngest males (33.5 and 39.5 millimeters) and the youngest females (47 to 71.5 millimeters) have the dorsal border of the rostrum almost straight, only a very slight convexity over the eye being apparent. As the "mâles féminisés" (those similar in general appearance to females) and females increase in body length, the convexity becomes gradually more pronounced. In the largest males it is very striking, but in the largest females it is not so much so. The young and middle-aged males which take on the adult characters usually show a greater curvature of the dorsal border of the rostrum over the eye than do the "mâles féminisés" of the same size. Correlated with this increase in the convexity, as these males and

[27] Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien (1892), 2, 421.

[28] *Arch. f. Naturgesch.* (1868), 5, 41.

females become more nearly mature there is an increase in the distance between the longitudinal ridge on the side of the rostrum and the dorsal border. At the same time there is a decrease in the relative length of the rostrum, so that the rostrum of younger individuals is a rather narrow blade while that of the older individuals is a broader blade.

The dental formula for the males (33.5 to 144 millimeters) is $\frac{11,\ 12,\ 13}{2,\ 3,\ 4,\ 5}$, while that for the few females in our collection is, with one exception, $\frac{11,\ 12,\ 13}{3,\ 4}$. As in the local form of *Palaemon carcinus*, there is no evidence that the number of teeth on the rostrum increases with age. It should be mentioned that the exception referred to above is a female 93 millimeters long, in which the rostral formula is $\frac{18}{3}$ (Table II). This specimen has recently carried eggs, and has a rostrum similar in shape to the largest males. The living color markings agreed exactly with those of other females of this species. The chelipeds, in shape, armature, and proportion, are much like the chelipeds of specimen 37 (97 millimeters) indicated in Table II. I have hesitated before diagnosing this individual as *P. philippinensis*, but as I can find no character which would rule out the specimen, except the large number of teeth on the dorsal border, I am forced to include it. In young and middle-aged males the teeth 9 and 10, or 10 and 11, or 11 and 12, or 12 and 13 on the dorsal border of the rostrum are more widely separated from one another than those farther back. The comparatively wide space between any two or any three of the teeth just mentioned is very evident in the young, but it decreases gradually as the animal grows larger, until in the largest males these teeth are almost evenly spaced. Similar prominent spaces are seen on the young, middle-aged, and older females. The first, second, and third teeth are usually found on the carapace in both males and females, although occasionally the third is astride of the edge of the orbit. The distance between the first and second and usually also between the second and third is greater than that between the teeth immediately succeeding. The lower border of the rostrum in both sexes and at all ages curves upward in its distal two-thirds, but this upward curving is not so pronounced in old age. The most distal tooth of the lower border is almost invariably at a considerable distance from the tip of the rostrum.

The specimens of *Palaemon philippinensis* in our collection bring out the following facts concerning the rostrum in this species:

1. The rostrum increases in length as the body grows longer.
2. Its relative length compared with the length of the antennal scale becomes less with increasing age, and only in the young does it extend beyond the tip of the scale.
3. The convexity of the dorsal border over the eye increases as the individuals grow more mature, and as a result the distance between the longitudinal ridge on the side of the rostrum and the dorsal border increases greatly.
4. The wide spacing between the teeth near the tip of the rostrum decreases with age, and almost disappears in old males.

Relative position of first antennæ and rostrum.—The peduncle of the first antenna retains the same relative proportions with reference to the antennal scale of the second antenna throughout life, and never extends to the tip of the scale. Generally in young and middle-aged males and females the peduncle of the first antenna extends to about the third or fourth tooth of the lower border of the rostrum, but in the largest specimens, especially the males, it reaches or almost reaches the tip of the rostrum. Small males which have taken on the mature male characteristics (young mature males) also sometimes show the tip of the peduncle even with the tip of the rostrum (Table II, No. 13). The relative position of the tip of the rostrum and the tip of the peduncle of the first antenna at different ages reminds one of the condition in the local form of *Palaemon carcinus,* although in a series of *Palaemon philippinensis* arranged according to increasing body length the approximation of the tips of the peduncle and rostrum does not take place so gradually and uniformly with increasing body length as in the former.

First pair of legs.—In the smallest males and females a portion of the propodus extends beyond the tip of the antennal scale, while in larger males and females a portion of the carpus is also seen extending beyond it (Table II).

Chelipeds.—The chelipeds of small males and females are shorter than the body, and with certain exceptions this condition persists with increasing body length, although the chelipeds of larger individuals show a relatively greater length compared with that of the body (Nos. 1a, 2, 5, 7, 8, 9, 10, 12, 14, 16, 17, 18, 19, 20, 21, 22, 25 (?), 32, 33, 34, 35, 36, 37, 38, 39). The exceptions mentioned are the large mature males (Nos. 26, 27, 28, 29, 30, 31) and the smaller males which have taken on the mature characters (Nos. 3, 4, 6, 11, 13, 15, 23, 24). By mature charac-

ters are meant the gaping of the fingers, the proportionately larger teeth on the fingers, the exceedingly long chelipeds, and the roughness of carapace, pleura, sixth abdominal somite, and telson.

All specimens of *P. philippinensis* in our collection possess fingers which are shorter than the palm, the next to the smallest male (No. 1a) showing a proportion of 1:1.22 and one of the largest males (No. 30) a proportion of 1:1.91. In general, as the body grows larger the palm increases in length at a greater rate than the fingers. A similar but much less marked proportional increase occurs in the females. The fingers of *P. philippinensis* show no signs of the long hairs or of the felted hairs which are characteristic of *P. nipponensis* and *P. carcinus*, respectively, but all specimens in the collection possess a few scattered tufts of hair, which do not obscure the underlying structures in the least. The teeth, which have been described above as present on the fingers of a large male, can be seen in the youngest males and females only with a high-power magnifying lens. They soon increase in size as the animal grows larger (90 millimeters), and become visible to the naked eye. In the small males (No. 3 and others that have taken on the mature form and which for convenience I have called young mature males) the teeth are conspicuous, their size being in proportion to the length of the cheliped. Two teeth on the mobile finger and 1 tooth (the distal) on the immobile finger are present in the youngest males and females (Nos. 1a and 32). In females and "mâles féminisés" of the size of No. 19 the small teeth back of the proximal tooth on the immobile finger are just beginning to form. The tips of the fingers curve inward at all ages and meet, except in the largest males and sometimes in the young mature males, where the immobile finger curves in much less and extends beyond the mobile finger. In small males, in "mâles "féminisés," and in all the females with the possible exception of No. 39, the fingers do not gape when closed, but in young mature males and especially in the old males the gaping is conspicuous. A keellike cutting edge is found on both fingers of all males and females. This is rather high and sharp in young males (including "mâles féminisés" and young mature males of smaller size), but it decreases in height markedly with increasing body length in the young mature males and less rapidly in the "mâles féminisés" and females. In the large males Nos. 30 and 31 and the older young mature males Nos. 23 and 26, the keel is reduced to an inconspicuous raised line which can be seen only with a magnifying lens. The tubercles

mentioned in the description of the large male as being present along the outer and inner sides of the cutting edge of the mobile finger and along the inner side of the immobile finger cannot be seen in the smallest males (Nos. 1a and 2) nor in any of the females except No. 39, in which they are slightly developed. In the smallest young mature male (No. 3) they show slightly, becoming better developed in specimens of larger size (Nos. 4, 6, 11, 13, 15, 23). "Mâles féminisés," when sufficiently large (Nos. 7, 8, 9, 10, 12, 14, 16, 17, 18, 19, 20, 21, 22, 24, 25, 27), show the tubercles, but in one of these, No. 17, the row on the outer border of the cutting edge of the mobile finger is represented by only 2 tubercles. In No. 18 this row is not present, but the inner row on each finger is well developed, while in Nos. 7, 8, 9, and 10 only very few tubercles along the inner border of both fingers are seen. Numbers 14, 16, 20, 21, 22, 24, and 25 show the characteristic 2 rows on the mobile and 1 row on the immobile finger.

The palm in specimens of all sizes and sexes is similar in shape to that of the larger male already described. In young specimens the fingers are a little shorter than the palm (1: 1.22 in No. 1a), but as the body length increases the palm grows faster than the fingers, until in the oldest male the fingers are only a little more than half the length of the palm. It is probable that smaller specimens than those in our collection would show the fingers equal to, or even shorter than, the palm.

The carpus, which is cylindrical in cross section and a little shorter than the propodus in all our specimens, increases gradually in diameter, passing from the distal to the proximal end. The palm is always shorter than the carpus, but a comparison of lengths at different ages indicates, in general, that the palm grows a little faster than the carpus, although considerable variability is seen in a series arranged according to the body length.

The relative lengths of the merus and carpus are shown in Table II, where the specimens are arranged according to increasing body length. Here again much variability appears, but if the young mature males are separated the variability is not so marked. The proportions given in Table II show clearly that, in general, the merus of the male does not increase in length as fast as the carpus. This condition is not evident in the small number of females we have in the collection. A similar and no less striking increase in the proportion of the merus to the carpus may be seen in the specimens of *P. ritsemae* de Man examined

by Coutière,[29] and I believe that large series of *P. idae* Heller [30] and *P. rudis* Heller [31] will show the same thing. The merus, which is flattened dorsoventrally along the proximal part, becomes almost cylindrical in cross section and of greater diameter at the distal part. As in other palaemons, the merus grows more rapidly than the ischium. While Table II shows that there is some variability in the proportion between the merus and ischium when a series of specimens is arranged according to increasing body length, it may also be seen that when the measurements for young mature males are separated from the rest this variability is much reduced.

The description of the shape of the ischium given for the largest male applies to specimens of all ages and sexes.

The chelipeds of young specimens show spines on the palm and anterior part of the carpus, but the "linear spaces" are not distinguishable. The covering of spines increases as the animals become larger, but it is not until they have reached about the middle size that the spines become apparent on the fingers and ischium. The "linear spaces" then show clearly.

Third, fourth, and fifth legs.—The third legs are missing in specimen 1a. One-quarter and two-fifths of the propodus extend beyond the tip of the antennal scale in the fourth and fifth legs, respectively. The measurements for the propodus of the fifth leg are 0.16 millimeter in diameter at the middle and 7 millimeters in length. In No. 16 the third, fourth, and fifth legs extend with two-thirds, two-fifths, and one-fourth of the propodus, respectively, beyond the antennal scale. The propodus of the fifth leg is 0.7 millimeter in diameter at the middle and 17 millimeters in length. A large specimen measuring 133 millimeters (not indicated in Table II) shows one-fourth of the propodus of the third leg extending beyond the antennal scale. In this specimen the dactylus of the fourth leg extends beyond the scale, while in the fifth leg merely the tip of the dactylus overreaches the scale. The propodus of this leg is 19 millimeters in length, and 1 millimeter in diameter at its middle point.

Telson.—The armature of the telson varies with the size, but the difference may be due to wear. In a young female 47 millimeters long (Plate II fig. 2*l*) the tip of the telson is long, the externolateral spines are well developed, and the internolateral spines are very long, with almost three-fourths of their

[29] *Ann. Sci. Nat., Zool.* (1900), 11, 314.
[30] *Sitzungsber. Akad. d. Wiss., math.-nat. Klasse,* Wien (1862), 45, 416.
[31] Reise der Österreichischen Frigatte Novara (1868), 2, 115.

length reaching beyond the tip of the telson. This condition figured by Ortmann.[32] In older specimens (Plate II, fig. 2*k*), however, the tip, the externolateral spine, and the internolateral spines are proportionally much shorter.

Character of surface.—All females and all "mâles féminisés," with the exceptions of Nos. 20 and 22, present no areas of spinules on the carapace, telson, or abdominal somites. Nos. 20 and 22 are slightly rough to the touch along the anterior part of the carapace. All of the young mature males and the old males show the characteristic areas of spinules described above for the largest male specimen.

Eggs.—The eggs of *P. philippinensis,* when preserved, measure about 1 by 1.3 millimeters.

Color of living specimen.—*Palaemon philippinensis* is not brilliantly colored. The surface is translucent, showing an underlying ground color of gray which is usually punctated on the dorsal and lateral regions of the abdomen and carapace with fine brownish red dots. The telson is usually bright brownish red in color, although not conspicuously so. The following striking pigment marks which may be seen through the translucent carapace are characteristic of the species (Plate II, fig. 2*m*):

1. Two usually brownish black lines running longitudinally on each side of the dorsal median line of the carapace.
2. A conspicuous T-shaped dark pigment mark seen on the posterior part of each gill cover.
3. Usually a dark, obliquely placed pigment mark immediately back of the hepatic spine.

The first and second antennæ are marked with brownish red and show no blue color. Along the ventral border of the pleura of the fourth and fifth abdominal somites is a purple band. The first, third, fourth, and fifth legs are translucent and punctated with reddish brown dots, while the chelipeds are dark in color and marked longitudinally with dark greenish bands. The color of the pigment varies somewhat in different specimens and also probably in the same specimens at different times. The color disappears almost entirely after preservation. In the young mature males and sometimes in the adult males a covering of brownish sediment often obscures the color, but the sediment may be rubbed off, leaving the markings visible.

Localities.—We have in our collection 31 males and 8 females, all but one of which were taken in San Juan River (usually

[32] *Zool. Jahrb., Systematik* (1891), 5, Tafel XLVII, Fig. 4.

fresh) which empties into Pasig River near Manila. The one specimen just mentioned was captured in an estero (brackish water) emptying into Pasig River in the city of Manila. It is very probable then that *P. philippinensis* might be taken in considerable numbers in brackish water.

Palaemon sundaicus Heller. Plate II, figs. 3 and 3*a-f*.

There is in our collection a fairly complete series of a palaemon which may be distinguished in life and sometimes in the preserved condition from other species found near Manila by the beautifully marbled or tortoise-shell-like markings on its chelipeds. This form is probably *Palaemon sundaicus* Heller,[33] although there are certain differences which will be mentioned below. The young specimens in our collection agree very well with the descriptions of de Man and Coutière for *P. sundaicus*, but our series contains a number of much larger males exhibiting characters which have not been described by Heller, de Man,[34] or Coutière.[35] I regret that I have not been able to see the paper of Hilgendorf.[36]

A study of the females and the young males in our series shows how closely they resemble specimens of like size described by the authors mentioned above. The shape, length, and dental formula of the rostrum and also the relative lengths of the different segments of the chelipeds are strikingly similar. In our collection the males reach a larger size than the females, the former ranging from 59.5 to 108 millimeters, the latter from 53.5 to 89 millimeters. Unfortunately, both de Man and Coutière had small collections, the individuals of which were mostly females, and in all cases the males which they examined were no larger than the smallest males in our series.

The fingers of the chelipeds in all of our males except the smallest are covered with felted hair which increases in thickness as the animals become larger. This does not seem to be true of any of the males described by de Man or Coutière, although it must be mentioned that all of our specimens bearing this felt are larger than any specimens described by these authors. Another difference is that in our series we have males of medium size (young mature males) in which the fingers gape widely and in which the relative length of the segments of the chelipeds

[33] *Sitzungsber. Akad. d. Wiss., math.-nat. Klasse*, Wien (1862), 45, 415.

[34] Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien (1892), 2, 437.

[35] *Ann. Sci. Nat., Zool.* (1900), 11, 332.

[36] Land und Süsswasser-Dekapoden Ostafrikas (1899), 130.

differs considerably from the specimens described by de Man and by Coutière.

The specimens listed in Table III were all seen by me while they were still alive. Judging from certain characteristic color markings, especially the pattern on the chelipeds, which were present in specimens of all sizes and sexes, one could not fail to include them under one species. Even the young mature males (Nos. 15 and 20) with the exceptionally long chelipeds showed the characteristic markings.

Notwithstanding the differences between our large males and the smaller males described by de Man, I do not feel justified in establishing a new species until larger collections of the Javan form are made.

While I have not been able to see any figures or specimens of the American species, *Palaemon acanthurus* Wiegmann,[37] except Ortmann's [38] drawing of the telson which agrees well with young individuals of this species, the descriptions indicate that it is a larger form, although I believe our series does not include the largest specimens to be found. The proportion of the palm to the fingers in old males and the shape of the rostrum are different, but the coat of felted hairs on the fingers of the males is present in both. I believe that *Palaemon acanthurus* Wiegmann and the form under consideration are closely related, and I should not be surprised if, when further collections of *Palaemon sundaicus* from Java are made, older males with more mature characters are brought to light which will ally the Javan species closer to *Palaemon acanthurus*.

Rostrum and antennal scales.—The position of the tip of the rostrum with reference to the tip of the antennal scale does not vary much in our specimens. In both males and females the tip may be even with, extend slightly beyond, or fail slightly to reach, the distal end of the scale. It is possible, however, that in larger males the rostrum may not extend so far forward.

Curvature and dental formula of rostrum.—There is little difference in the shape of the rostrum in the males and females of all ages. The distal third is turned upward somewhat, and there is in nearly every case a gentle convexity over the eye. Usually there are 3 rostral teeth on the carapace, the fourth being over the edge of the orbit, and rarely are there 2 or 4 on the carapace. The rostral ridge divides the lateral surface of the rostrum into an upper and a lower area which are of

[37] *Arch. f. Naturgesch.* (1836), 1, 150.
[38] *Zool. Jahrb., Systematik* (1891) 5, Tafel XLVII, Fig. 5.

about equal width. Usually those teeth which are near the distal end of the upper border are separated from one another more than those posterior to them. The first tooth is nearly always separated from the second tooth by a distance which is considerably greater than the distances separating the teeth immediately anterior to them. The dental formula for the specimens in the collection is $\frac{9,\ 10,\ 11,\ 12,\ 13}{4,\ 5,\ 6,\ 7}$, but the large majority of the females show a dental formula of $\frac{10,\ 11}{5}$.

First pair of legs.—The first legs extend beyond the tip of the antennal scale in all specimens; in the youngest, only the propodus is seen beyond it, but in larger specimens more of the first legs overreaches the scale, and finally in the largest individuals as much as one-third of the carpus extends beyond it.

Chelipeds.—The chelipeds in this species are approximately equal. All the females have chelipeds which are shorter than the body, and the same is true of practically all the males until they reach a length of about 77 millimeters. Beyond this size the chelipeds are usually longer than the body, and in certain specimens, Nos. 15, 16, and 17, which I consider to be young mature males, they are relatively long. In the largest female, No. 38, the tip of the merus extends beyond the antennal scale, while in the smallest female, No. 25, three-fourth of the carpus overreaches the scale. One of the largest males, No. 20, shows more than one-half of the merus beyond the scale, while in the smallest male only four-fifths of the carpus extends beyond it.

It will be seen, if reference is made to Table III, that the fingers of all individuals are shorter than the palm, except in Nos. 1 and 2, which are the smallest males in the series. In the case of the males the palm seems to grow much faster than the fingers, so that an individual 88 millimeters long (No. 14) has a palm one and two-thirds times as long as the fingers. One of the young mature males, No. 20, shows the palm to be one and three-fourths times as long as the fingers. The largest males in the series have chelipeds which are shorter than the body length except in the case of No. 23. At first sight I considered these specimens to be "mâles féminisés," but upon examining them more closely I find that they have well-developed spines on the carapace and abdominal somites and I am of the opinion that these individuals are old mature males whose chelipeds are regenerating. The palm of the largest male, No. 24, is a little more than one and one-half times the length of the fingers.

TABLE III.—*Palaemon sundaicus Heller.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Carapace length (posterior face of eye to posterior border of carapace).	Rostral formula.	Position of tip of rostrum with reference to antennal scale.	First pair of legs (extension beyond antennal scale).	Extension of chelipeds beyond antennal scale.
		mm.	*mm.*				
1	♂	59.5	14.0	10/5	Even	Propodus	Four-fifths of carpus.
2	♂	66.5	15.5	12/5	do	Tip of carpus	Do.
3	♂	66.5	16.0	11/5	do	do	Do.
4	♂	70.0	17.0	13/5	Slightly beyond	One-fourth of carpus	Whole of carpus.
5	♂	71.0	18.5	11/4	Even	do	Do.
6	♂	71.0	17.0	11/5	Slightly beyond	Tip of carpus	Do.
7	♂	75.0	18.5	9/4	do	do	Almost whole of carpus.
8	♂	*71.5	19.0	11/6	Slightly behind	do	Whole of carpus.
9	♂	77.0	19.0	11/5	Slightly beyond	do	Tip of merus.
10	♂	77.0	20.0	10/5	do	One-third of carpus	Carpus.
11	♂	82.0	20.5	12/6	do	do	Almost one-third of merus.
12	♂	82.0	20.5	11/6	do	do	Absent.
13	♂	82.0	22.5	11/5	do	do	Tip of merus.
14	♂	88.0	24.5	10/5	Even	do	Two-fifths of merus.
15	♂	90.0	24.0	11/5	Slightly beyond	One-third of carpus	One-half of merus.
16	♂	91.5	25.0	11/5	do	One-fourth of carpus	One-third of merus.
17	♂	93.5	25.0	10/6	do	Two-fifth of carpus	Absent.
18	♂	92.0	25.0	10/5	Considerably behind	Almost one-half of carpus	Do.
19	♂	*99.0	26.0	10/5	Slightly behind	One-third of carpus	Do.
20	♂	*(?)	26.0	(?)	(?)	Almost one-half of carpus	More than one-half of merus.
21	♂	100.5	28.0	11/5	Even	do	Absent.
22	♂	102.0	28.0	10/5	do	One-third of carpus	Almost all of carpus.
23	♂	107.0	28.0	10/5	do	do	Distal end of merus beyond.

24	♂	108.0	27.5	11/5	----do	----do	Do.
25	♀	[b]53.5	13.5	12/6	Slightly beyond	Propodus	Three-fourths of carpus.
26	♀	[b]54.0	13.0	11/5	----do	----do	One-third of carpus.
27	♀	[b]57.0	14.0	10/5	Even	Tip of carpus	Three-fourths of carpus.
28	♀	57.0	14.0	11/5	----do	----do	Seven-eighths of carpus.
29	♀	60.0	15.0	11/5	Slightly beyond	----do	Two-thirds of carpus.
30	♀	63.0	16.0	11/5	Slightly behind	----do	Four-fifths of carpus.
31	♀	66.0	16.5	10/5	Even	----do	Carpus.
32	♀	68.5	16.0	11/5	Slightly beyond	One-fifth of carpus	Almost whole of carpus.
33	♀	[b]74.0	18.0	10/5	Slightly behind	----do	Do.
34	♀	75.5	19.5	11/6	Even	One-fourth of carpus	Carpus.
35	♀	79.0	20.0	11/5	----do	One-fifth of carpus	Tip of merus.
36	♀	79.0	21.0	10/5	Slightly behind	Tip of carpus	Almost all of carpus.
37	♀	87.0	23.0	10/5	Even	One-fifth of carpus	Carpus,
38	♀	89.0	23.5	10/5	Slightly behind	One-third of carpus	Tip of merus.

No.	Sex.	Chelipeds.								
		Length of—						Total length beginning with ischium.	Gaping of fingers.	Felt on fingers.	Proportion of merus to carpus.
		Propodus.	Fingers.	Palm.	Carpus.	Merus.	Ischium.				
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			
1	♂	17.0	8.5	8.5	12.0	9.0	8.0	46.0	None	None	1.33
2	♂	17.0	8.5	8.5	15.0	10.0	8.5	50.5	----do	----do	1.50
3	♂	17.5	8.0	9.5	15.0	11.0	8.0	51.5	----do	----do	1.36
4	♂	22.5	10.0	12.5	19.5	12.0	10.0	64.0	----do	Short, but present on both fingers.	1.62
5	♂	19.5	9.0	10.5	18.5	11.5	10.0	59.5	----do	Present, but shorter than in No. 4.	1.60
6	♂	24.0	9.5	14.5	19.5	13.0	10.0	66.5	----do	Short, but fairly well developed.	1.50

[a] Tip of rostrum broken.

[b] Without eggs.

TABLE III.—*Palaemon sundaicus Heller*—Continued.

No.	Sex.	Chelipeds.									
		Length of—						Total length beginning with ischium.	Gaping of fingers.	Felt on fingers.	Proportion of merus to carpus.
		Propodus.	Fingers.	Palm.	Carpus.	Merus.	Ischium.				
		mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*			
7	♂	21.0	9.0	12.0	18.0	12.0	11.0	62.0	None	Very short	1.50
8	♂	26.0	11.0	15.0	22.0	14.0	11.0	73.0	do	Short, but fairly well developed.	1.57
9	♂	28.5	12.0	16.5	23.0	15.0	12.0	78.5	do	do	1.53
10	♂	25.0	10.0	15.0	21.5	14.0	11.0	71.5	do	Shorter	1.53
11	♂	32.0	13.0	19.0	29.0	17.5	13.0	91.5	do	Short, but fairly well developed.	1.65
12	♂										
13	♂	32.5	13.0	19.5	28.5	17.0	13.5	91.5	None	Short, but fairly well developed.	1.64
14	♂	40.5	15.5	25.0	34.0	20.0	15.0	109.5	do	Increasing	1.70
15	♂	55.5	21.5	34.0	48.0	27.0	17.0	147.5	Wide gape	Thick	1.77
16	♂	42.5	16.5	26.0	34.5	21.0	16.0	114.0	Slight gape	Well developed coat	1.64
17	♂										
18	♂										
19	♂										
20	♂	55.0	20.0	35.0	48.0	31.0	19.0	153.0	Wide gape	Thick	1.54
21	♂										
22	♂	a30.0	12.0	18.0	25.0	19.0	14.0	88.0	None	Short	1.31
23	♂	a40.0	15.0	25.0	32.0	22.5	15.0	109.5	Slight gape	do	1.42
24	♂	34.5	13.5	21.0	30.0	21.0	15.0	100.5	None	do	1.42
25	♀	13.0	6.0	7.0	12.0	8.5	7.0	40.5	do	Absent	1.41
26	♀	14.5	6.5	8.0	10.5	8.0	7.0	40.0	do	do	1.31
27	♀	14.5	7.0	7.5	11.0	8.5	6.5	40.5	do	do	1.29

28	♀	16.0	7.0	9.0	12.0	8.5	8.0	44.5	---do---	1.41
29	♀	17.0	8.0	9.0	12.0	9.0	7.0	45.0	---do---	1.33
30	♀	18.0	7.0	11.0	15.0	10.0	8.5	51.5	---do---	1.50
31	♀	20.0	9.0	11.0	15.0	10.0	9.0	54.0	---do---	1.50
32	♀	16.5	7.5	9.0	15.0	10.0	9.0	50.5	---do---	1.50
33	♀	23.0	10.0	13.0	18.0	12.0	9.5	62.5	---do---	1.50
34	♀	23.0	11.0	12.0	17.0	11.5	10.0	61.5	---do---	1.47
35	♀	25.0	11.0	14.0	21.0	14.0	11.0	71.0	---do---	1.50
36	♀	25.0	11.0	14.0	19.0	13.5	10.5	68.0	---do---	1.40
37	♀	26.5	11.5	15.0	23.0	14.0	11.5	75.0	---do---	1.64
38	♀	31.0	13.0	18.0	25.0	16.0	13.0	85.0	---do---	1.56

[a] Right cheliped only present, and this very short. Probably regenerating.

The fingers and palm are more nearly of the same length in the females, the palm being one and two-fifths times as long as the fingers in the largest individual. All of the male individuals, except the three smallest (Nos. 1, 2, 3), have both fingers of the chelipeds covered with felted hair, a condition which is not found in the females. The fingers of both males and females are slender, and each has a rather low cutting edge, extending from the teeth to the tip. The youngest males (Nos. 1 and 2) and all the females, except No. 25, show 2 teeth on the mobile and 1 tooth on the immobile finger. In No. 25 only 1 tooth is seen, and this is situated on the mobile finger. The males, Nos. 3 to 13 and 22 to 24, inclusive, show 2 teeth on the mobile finger and 2 on the immobile, but in the young mature males the teeth on the immobile finger are increased in number by the addition of 2, 3, or even 4 confluent teeth, which are situated between the most proximal of the two teeth just mentioned and the joint, a condition which is characteristic of mature males in some other species at least.

The palm is almost cylindrical, that of the smallest measuring 2 by 2.5 millimeters at its middle and that of the large male, No. 20, measuring 4.5 by 5 millimeters at a similar point.

The carpus is cylindrical in cross section, and increases gradually in diameter passing from the proximal to the distal end. It is shorter than the propodus and longer than the palm, but it does not increase in length so fast as does the palm. In the mature males there is a slight swelling of the carpus a little posterior to the distal end.

The proportion of the merus to the carpus ranges from 1 : 1.33 to 1 : 1.77, and the measurements indicate that the carpus grows faster than the merus. The latter is slightly longer than the palm in the young but slightly shorter in old individuals. It is always shorter than the carpus and longer than the fingers. The merus, which is flattened dorsoventrally along the proximal part, becomes almost cylindrical and of greater diameter at the distal part.

As in other palaemons, the merus grows faster than the ischium, so that the proportion between the ischium and merus increases with increasing body length. In the young mature males this increase is especially evident. The ischium is flattened dorsoventrally, the upper and lower surfaces being divided into two regions by a median longitudinal groove.

Third, fourth, and fifth legs.—The third, fourth, and fifth legs extend with their dactyli beyond the tip of the antennal scale in young individuals of both sexes. In older individuals as much

as one-fifth or one-third of the dactyli may extend beyond. The propodus of the fifth leg (No. 1) measures 0.5 millimeter in diameter at its middle and 8.75 millimeters in length. Similar measurements for Nos. 24, 25, and 38 are 0.8 by 15, 0.3 by 7.5, and 0.6 by 13 millimeters, respectively.

Telson.—Specimens in which the telson has not been worn show the internolateral spines extending about two-thirds of their length beyond the acute median spine. The externolateral spines are short and of about the same length as the median spine. In some specimens the tip of the telson is worn and the internolateral spines are considerably shortened.

Character of surface.—The carapace and abdominal somites of all females and males (Nos. 1 to 13, inclusive) are smooth to the touch, and show no spines under a lens. Male specimens larger than these have patches of spinules on the carapace, pleura of abdomen, tergum of sixth somite, upper surface of uropods, and the telson. These spinules are especially numerous on the young mature males, and the surface is distinctly rough to the touch. The surface of the first pair of legs is smooth, except in the old males where the ischium and part of the merus are covered with a few spinules. The spines on the chelipeds make their appearance at an early age. Specimen 1 shows a few rather indistinct rows of spines on the palm and distal half of the carpus. The area of spines increases with the body length, so that in No. 4 it covers the proximal end of the finger, the palm, the carpus, and the distal half of the merus. In No. 8 the condition is similar except that the ischium also is covered. Young mature males, as an example, No. 20, show a few spines at the proximal end of the fingers and about 12 longitudinal rows of medium-sized spines, which are distributed on the inner, ventral, and dorsal surfaces of the palm. The outer surface of the palm is covered with innumerable very small spines, which are not arranged regularly in rows. A similar condition exists on the carpus, merus, and ischium. The dorsal and ventral "linear spaces" are visible especially on the palm, carpus, and merus. In middle-sized specimens the "linear spaces" are more conspicuous. The third, fourth, and fifth legs are smooth in all but the largest males, where the propodus, carpus, and sometimes the merus are covered with very minute spinules.

Eggs.—The eggs of this species when preserved are almost spherical, and average 0.5 by 0.46 millimeter.

Color of the living specimens.—The general surface of the body owes its color mainly to the layer of pigment cells under the transparent chitinous covering. The color is not always the

same in any one individual. It may range from green to blue or even to brick red, and in old specimens these colors may be partially obscured. No T-shaped, L-shaped, or diagonal markings are seen under the sides of the carapace, but in living specimens the chelipeds are conspicuously marked, so as to appear like tortoise shell (Plate II, fig. 3*c*). These markings, which are probably the same as the marbled markings spoken of by de Man, sometimes persist temporarily after preservation, but usually disappear as do all other colors mentioned. The uropods are colored a conspicuous red, and there is a purple spot on the posterolateral portion of the exopodite. The internal flagella of the first pair of antennæ are marked on their dorsal surface with bright yellow, and similar yellow spots are also seen on the uropods and telson. The color notes which have just been given apply to both sexes, but there are certain markings which distinguish the males from the females. A cream-colored transverse band on the tergum of the third abdominal somite is present in all the females of this species, but in the males it is much reduced in size or almost absent. This band is found in some other species which are described below. In the females the ventral border of the pleura of the fourth and fifth somites has a blood-red color which is absent in the males.

Localities.—We have in our collection 73 females and 24 males. Most of these were collected in Obando River flowing into Manila Bay near Manila (brackish water); some were taken in San Francisco River (usually fresh), which is a branch of Pasig River; others were obtained from an estero (often brackish) emptying into Pasig River within the city of Manila. Nos. 2, 6, 7, 9, 12, 17, 19, and 21 (Table III) are from San Francisco River.

Palaemon lanceifrons Dana. Plate II, figs. 4 and 4*a*.

The collection contains several palaemons which agree well with Dana's [39] description of *Palaemon lanceifrons*. The fingers of the chelipeds are about equal to the palm in most specimens, although in the old mature males (Dana's specimen was evidently a rather old male) the fingers are considerably shorter than the palm and are two-fifths of the length of the propodus. (Plate II, figs. 4 and 4*a*.) The propodus is a little longer than the carpus in all cases and a little slenderer. Characteristic tubercles (not mentioned in Dana's description), teeth, and thick hair are

[39] United States Exploring Expedition, Crustacea (1852–1854), 13, 589.

present on the fingers. These structures are described below in a description of a local form of this species.

The dental formula is $\frac{10, 11, 12, 13}{3, 4, 5}$, and the shape and size of the head and rostrum agree very well with Dana's figure. The rostrum never extends beyond the antennal scale, and is decidedly convex over the eye in older specimens.

The general surface of the body is sometimes dark and sometimes light. The color is due partly to closely set brownish pigment spots, which often have a dark reddish tinge, and in addition to this ground color there are patches of yellowish cream flecks scattered over the surface. Usually the tips of the uropods and the telson have a reddish brown color. The characteristic markings of this species (Plate II, fig. 5*g*) are an almost straight diagonal mark, an inverted V-shaped mark, and 2 marks shaped like an inverted L. These are often bluish in color, and may always be seen more or less clearly on the sides of the carapace. The horizontal limb of the anterior inverted L extends posteriorly from the anterior border of the carapace, ventral to the spines. The posterior inverted L is situated back of the anterior inverted L, and its horizontal limb is on a level considerably higher than that of the former. The diagonal mark, which really lies on the tissues beneath the carapace and is seen on account of the transparency of the latter, extends from the point where the horizontal and vertical limbs of the posterior L meet to the posterior margin of the carapace. Finally, the inverted V-shaped mark lies directly above the anterior L. The first and second antennæ are never colored blue, but are usually marked, especially in the male, with reddish brown transverse bars. The second legs or chelipeds are mottled in a manner somewhat similar to that of *Palaemon sundaicus,* but the coloring is reddish brown and greenish cream, and does not resemble tortoise shell in appearance.

Palaemon lanceifrons Dana, judging from our specimens, is distinct from *Palaemon idae* Heller. The carpus is always shorter than the propodus, and the proportion is about the same throughout the series. Furthermore, the chelipeds of *P. lanceifrons* are thicker and the rostrum is broader.

I agree with de Man's statement that *P. lanceifrons* is distinct from *P. sundaicus.* The shape of the rostrum, the shape of the different. The color markings and the tubercles on the fingers, fingers, and the distribution of the hair on the fingers are

which are seen in our specimens of *P. lanceifrons*, are absent in *P. sundaicus*.

Palaemon lanceifrons is not the young of *Palaemon philippinensis*. The latter has differently shaped fingers, there is no thick coating of hair on them, the eggs are much larger, and the color markings are different.

De Man's [40] suggestion that *Palaemon lanceifrons* Dana is possibly identical with *Palaemon dispar* von Martens receives considerable support from my observations. I believe that the former is very closely related to the latter, the only differences being found in the shape of the rostrum, the number of proximal teeth on the fingers, the number of distal tubercles on the fingers, and the shape of the tip of the immobile finger. Further collections and an actual comparison of specimens of the two species may show them to be identical.

There are 9 males and 24 females of this species in the collection; they were all purchased in a Manila market. Nearly all the females bear eggs. These measure from 0.5 to 0.7 by 0.6 to 0.8 millimeter.

A local form of *Palaemon lanceifrons* Dana, collected in San Juan River near Manila, differs slightly from the specimens just described. Except for minor differences, the chelipeds have the same proportions and general characteristics. The rostral formula is practically the same, but the rostrum is slightly longer and is less convex over the eye.

Rostrum and antennal scale.—The rostrum extends about as far forward as the antennal scale, but in some cases fails to reach it or extends beyond it a very short distance.

Curvature and dental formula of rostrum.—The shape of the rostrum does not vary much, but it must be added that there are not many individuals in the collection and that they do not show a very great range in size. The tip of the rostrum of old and middle-aged specimens turns up slightly, but in the young it is straight. The rostrum usually has its origin rather far forward on the carapace, but in Nos. 5, 7, and 8 (Table IV) it arises from about the middle of the same. Usually, there are 2 teeth on the carapace, and the 4 distal teeth at the tip of the rostrum are more widely separated than the rest. The first and second teeth are more widely separated than those immediately anterior to them. The lateral surface of the rostrum is divided

[40] Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien (1892), 2, 419.

into an upper wider and a lower narrower region by the usual ridge. The dental formula varies somewhat $\left(\frac{10, 11, 12, 13}{3, 4}\right)$.

First pair of legs.—In young males about one-half of the propodus, in the middle-aged males the whole of the same segment, and in the old males the tip of the carpus extends beyond the antennal scale.

Chelipeds.—The chelipeds of the young specimen, No. 2, are equal in length, but in all the rest of the specimens in which the chelipeds are present they are unequal in length. This inequality seems to increase with age, and it seems probable that it is not due to injury and regeneration. Only in the mature males, Nos. 7 and 8, are the chelipeds as long as the body. In the youngest male only two-fifths of the carpus extends beyond the antennal scale, while in the mature males from one-fourth to one-third of the merus may be seen beyond it.

The fingers of the youngest male, No. 1, are longer than the palm, slightly older specimens show the fingers to be a little shorter than the palm, and the old mature males have fingers which are much shorter than the palm. In specimen 8 the proportion of the fingers to the palm is 1:1.66 (left cheliped) and 1:1.44 (right cheliped). Thick hair is not present on the fingers of the youngest specimens, Nos. 1 and 2, but it makes its appearance on both fingers in slightly older individuals. The mature males have a thick coating of hair, which covers all but the tip of the mobile finger. The immobile finger bears a small patch of hair, which is limited to a narrow region extending as far forward as the middle of the finger on both sides of the cutting edge. Four broad and inconspicuous tubercles bearing a few stiff hairs are present along the inner side of the cutting edge of the immobile finger. These are situated on the swollen distal half, and are only seen in the mature males, Nos. 7 and 8. The mobile fingers of the specimens just mentioned have 3 long low tubercles along the inner side of the cutting edge. They are situated on the distal half of the finger. The keel of the cutting edge is well developed but low in the young and middle-aged individuals, and it becomes reduced to a raised line in the mature males. The youngest male, No. 1, shows 2 teeth on the mobile finger and 1 tooth on the immobile finger, but these may be seen only through a strong lens. In specimen 3, the beginnings of 1 or 2 confluent teeth posterior to the large tooth of the immobile finger are present. In the mature males, Nos. 7 and 8, there is an indication of the beginning of a

TABLE IV.—*Palaemon lanceifrons Dana.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Carapace length (posterior face of eye to posterior border of carapace.	Rostral formula.	Position of tip of rostrum with reference to tip of antennal scale.	First pair of legs (extension beyond antennal scale).	Extension of chelipeds beyond antennal scale.
1	♂	49.0	11.0	11/3	Slightly beyond	One-half propodus	Two-fifths of carpus.
2	♂	55.0	12.5	10/3	Even	do	Do.
3	♂	58.0	14.0	10/3	Slightly beyond	do	Two-thirds of carpus.
4	♂	58.5	14.5	13/4	Even	Propodus beyond	One-half of carpus.
5	♂	58.5	15.0	11/4	Slightly behind	Tip of carpus	Six-sevenths of carpus.
6	♂	62.5	15.0	12/4	Slightly beyond	Propodus beyond	One-half of carpus.
7	♂	63.5	16.0	12/4	Slightly behind	do	Tip of merus. One-third of merus.
8	♂	64.0	16.5	11/4	Slightly beyond	Tip of carpus	One-fourth of merus. Whole of carpus.

No.	Sex.	Chelipeds.									
		Length of—						Total length beginning with ischium.	Gaping of fingers.	Felt on fingers.	Proportion of merus to carpus.
		Propodus.	Fingers.	Palm.	Carpus.	Merus.	Ischium.				
1	♂	R. 8.5	4.5	4.0	8.0	5.5	5.0	27.0	None	None	1.45
2	♂	L. 9.5	4.0	5.5	9.0	6.5	6.0	31.0	do	do	1.38
		R. 9.5	4.5	5.0	9.0	6.5	6.0	31.0	do	do	1.38
3	♂	L. 13.0	6.0	7.0	11.0	7.5	6.5	38.0	do	Slight on both fingers	1.46
		R. 11.0	5.0	6.0	10.5	7.5	6.5	35.5	do	do	1.40
4	♂	L. 11.5	5.5	6.0	10.5	7.0	6.0	35.0	do	Slight	1.50
		R.									

5	♂	L. 15.5	7.0	8.5	14.0	9.0	7.5	46.0	do	Considerable on both fingers	1.55
		R. 14.0	6.0	8.0	13.0	9.0	7.5	43.5	do	do	1.44
6	♂	L. 12.0	6.0	6.0	11.0	8.0	6.5	37.5	do	Slight	1.37
		R.									
7	♂	L. 23.5	9.0	14.5	21.0	14.0	8.5	67.0	Wide	Thick	1.50
		R. 28.0	10.0	18.0	23.0	14.5	8.5	74.0			1.58
8	♂	L. 32.0	12.0	20.0	26.5	15.0	10.0	83.5	do	do	1.76
		R. 22.0	9.0	13.0	18.0	13.0	8.0	61.0			1.38

third confluent tooth and the first or most anterior confluent tooth is almost separated from those back of it. The large tooth of the immobile finger measures 1 millimeter in height, and the teeth of the mobile finger are about half as high (No. 8).

The palm is cylindrical in cross section, and is always shorter than the carpus. The proportion of the palm to the carpus in the smallest specimen is 1:2, and in the largest mature male the length of the palm is contained about one and one-third times in that of the carpus (No. 8).

The carpus reaches it greatest diameter some distance posterior to the distal end in mature males, and is cylindrical in cross section. In all of our specimens it is shorter than the propodus, but only slightly so in the immature specimens (Nos. 1–6).

The proportion of the merus to the carpus ranges from 1:1.37 to 1:1.76. The former is always longer than the fingers, and it is longer than the palm except in the mature males (Nos. 7 and 8).

Third, fourth, and fifth legs.—In the smallest male the dactylus of the third leg, one-fourth of the propodus of the fourth, and one-half of the propodus of the fifth leg extend beyond the antennal scale. The propodus of the fifth leg measures 8 millimeters in length, and has a width of 0.33 millimeter at its middle point. One-half of the propodus of the third leg extends beyond the tip of the antennal scale in the largest male, and one-third of the same segment of the fourth and fifth legs overreaches the scale, The measurements for the propodus of the fifth leg are 11.5 by 0.5 millimeters.

Telson.—The telsons of the two largest males and the smallest male are damaged. The tip in uninjured specimens is subacute, the externolateral spines fail to reach the tip of the telson by a distance equal to their own lengths, and the internolateral spines extend with three-fifths (No. 7) and two-thirds (No. 1) of their lengths beyond the tip.

Character of the surface.—The carapace and abdominal somites of all specimens except the two largest males, Nos. 7 and 8, are smooth. The last-mentioned mature males have the usual spinules on the pleura of the abdomen, the tergum of the sixth somite, the uropods, the telson, and the carapace. No spines can be seen on the legs of the smallest specimen. The surface of the first legs is smooth in all individuals except in the two largest males, where a few spines may be seen on the ischium. The chelipeds of No. 1 are smooth, and in No. 2 a few spinules may be seen on the immobile finger, the palm, and the car-

pus, but these are only visible under rather high magnification. In older specimens the spines are larger and cover the proximal part of the immobile finger, the palm, the carpus, the merus, and the ischium. The spines on the chelipeds are inconspicuous, being broad, low, and subacute. "Linear spaces" cannot be distinguished. Very minute spinules may be seen, with the aid of a lens, on the propodus, carpus, and merus of the third, fourth, and fifth legs.

Eggs.—There are no females of this form in the collection.

Color of the living specimens.—The color of these specimens agrees with that of the typical *Palaemon lanceifrons* Dana, the pigment marks on the sides of the carapace being plainly visible.

Locality.—All of these specimens were captured in San Juan River near Manila.

Palaemon lanceifrons Dana var. montalbanensis var. nov. Plate II, figs. 6 and 6*a-i.*

I have collected from the water supply of the city of Manila at Montalban 72 specimens of a form which I consider to be a variety of *Palaemon lanceifrons* Dana and one which in some respects is very similar to *Palaemon elegans* de Man. It is characterized by the decided convexity and shortness of the rostrum, by the fingers being much shorter than the palm in large specimens, and by the presence of tubercles in older males along the sides of the cutting edge of the fingers.

This variety, which I have called *P. l.* var. *montalbanensis,* differs from *P. lanceifrons* as originally described by Dana in the following particulars: The number of teeth on the dorsal and ventral borders of the rostrum is less, the rostrum does not extend so far forward, and the carpus is considerably shorter than the propodus even in young specimens.

Palaemon lanceifrons var. *montalbanensis,* while very similar to *P. elegans* de Man, differs as follows: The number of teeth on the dorsal and ventral borders of the rostrum is less; the teeth at the distal end of the dorsal border of the rostrum are spaced more widely; the chelipeds are unequal in length except in the young; the relative length of the fingers and palm of the chelipeds is different; the segments of the chelipeds are thicker; and the tubercles along the sides of the cutting edge of the fingers are distributed differently. Judging from the 37 males and 35 females in our collection, the mature females are much smaller than the old males.

The following description applies to the large male listed as No. 12 in Table V. This specimen, which measures 65.5 milli-

meters in length, has a rostrum which reaches the tip of the peduncle of the first antenna. The dorsal border of the rostrum begins at the middle of the carapace, but in this region and for some distance forward it is without teeth. The ventral border curves upward moderately, the tip extends directly forward, and the ridge along the side of the rostrum divides the blade into a wide upper and narrow lower area. The rostral formula is $\frac{9}{3}$, and the proximal and distal teeth of the dorsal border are more widely separated than those between them. On the ventral border the 2 teeth are situated well back from the tip.

The slender first pair of legs extends with the whole of the propodus beyond the antennal scale.

The chelipeds which are decidedly unequal in length extend with from one-third to one-half of the merus beyond the scale, and are both considerably longer than the body. Of the two chelipeds, the left is the longer, measuring 87 millimeters from the tip to the proximal end of the ischium; the right measures 75 millimeters, and is slenderer. The description which follows applies to the left cheliped: The immobile finger curves in less sharply and extends farther forward than the mobile finger. It is considerably more than half as long as the palm (1 : 1.68), and is distinctly swollen along its distal half. The keel of the cutting edge is reduced to a raised line, but a short distance in front of the proximal end of the finger there is a well-developed triangular tooth measuring 1.5 millimeters in height, which meets the cutting edge of the mobile finger and aids in preventing the fingers from closing. Posterior to the tooth just mentioned is a row of 3 much smaller confluent teeth (4 in specimen 14). All of these teeth are obscured by a thick growth of hair, which is limited to a narrow region on both sides of the cutting edge as far forward as the middle of the finger. Along the inner side of the cutting edge of the distal portion of this finger is a row of 5 broad, low, and inconspicuous tubercles, which bear a few stiff hairs. The sharply curved mobile finger is covered, except at the tip, with a dense coat of hair and is not swollen. The keel of the cutting edge is reduced as in the case of the immobile finger. Along the cutting edge are 2 teeth, measuring 1 millimeter in height, which curve slightly posteriorly. The palm is cylindrical in cross section and considerably shorter than the carpus (1 : 1.26). The carpus, which reaches its greatest diameter some distance back from the distal end, is much shorter than the chela (1:1.28), while the merus, which is only slightly

flattened at the posterior end, is much shorter than the carpus (1:1.57). The dorsal and ventral surfaces of the ischium each present a median longitudinal groove. The lengths, in millimeters, of the parts just described are as follows: Propodus, 33.5; finger, 12.5; palm, 21; carpus, 26; merus, 16.5; ischium, 11; total, 87.

The telson of this specimen ends in a subacute spine. The externolateral spines do not extend to the end of the telson, and the internolateral spines extend with about half their length beyond the tip. (See below, description of telson of smaller specimens.)

Patches of poorly developed spines are present on the anterior part of the carapace. Similar spines are seen on the ventral and lateral parts of the pleura, the dorsal surface of the sixth somite, and the exposed parts of the dorsal and ventral surfaces of the uropods and the telson. These spines are especially numerous on the last three structures named. The ischium of the first legs and the distal segments of the third, fourth, and fifth legs are covered with very fine spines, which are scarcely stronger than stiff hairs. The immobile finger, palm, carpus, merus, and ischium of the chelipeds are armed with short blunt spines, which are larger in size and fewer in number on the inner than on the outer surface of these segments. The mobile finger is spineless. "Linear spaces" cannot be seen.

Rostrum and peduncle of first antenna.—An examination of the 72 specimens in our collection shows that the rostrum may extend as far as the tip of the peduncle of the first antenna, may extend slightly beyond it, or may fail to reach it. In no case does the rostrum extend to the tip of the antennal scale, and there is no indication that the rostrum decreases in proportional length with reference to the peduncle of the first antenna.

Curvature and dental formula of rostrum.—There is little variation in the shape of the rostrum, but in the old males the convexity of the dorsal border is much more pronounced than in the females or young males. The tip does not turn up, the rostrum begins about halfway back on the carapace, and 1 or 2 teeth have their origin on the carapace. In all specimens the distal teeth of the dorsal border are more widely separated from one another than the teeth immediately posterior to them, and in the old males the first 2 teeth on the carapace are slightly more separated than those which immediately follow. The ridge

along the side of the rostrum divides the blade into an upper and lower region, the former being the wider of the two in specimens of all ages. The dental formula is very constant in all specimens $\left(\frac{8, 9, 10}{2, 3}\right)$.

First pair of legs.—The first pair of legs in young males and mature females extends with the tip of the propodus beyond the antennal scale, but in the large males the whole propodus is seen beyond the scale.

Chelipeds.—The chelipeds of the smallest males and all the females are approximately equal. An examination of Table V shows that in the males the inequality between the chelipeds increases with the increase in body length and that the difference in length is most marked in those specimens which show mature characteristics (Nos. 7, 8, 12). While it is difficult to determine whether this unequal length is the result of injury and regeneration or whether this condition is always characteristic of uninjured middle-aged and old males, the fact that none of the specimens in the collection shows chelipeds of such unequal length that there can be no doubt that the smaller one is regenerating indicates that the inequality is characteristic. The chelipeds of the females (Nos. 15, 16, 17), the "mâles féminisés" (Nos. 9, 11, 13), and the young immature males are shorter than the body (Nos. 1, 2, 3, 4, 5, 6). Young mature males and old mature males have the chelipeds longer than the body (Nos. 7, 8, 10, 12). In the smallest males, one-half of the carpus extends beyond the antennal scale, while in the largest males one-third of the merus may be seen beyond. The females do not show a great range in size, and a small fraction of the carpus only extends beyond the antennal scale.

The fingers of the youngest male, No. 1, are longer than the palm, and those of the youngest female, No. 15, are equal in length to those of the palm; in slightly larger males and females the palm becomes longer than the fingers, and in some of the largest males the fingers are contained one and one-half times in the palm. All of the male individuals except the smallest one have felted hair on the mobile finger, a condition which is not found in the females. There is also hair on the immobile finger of the males, but this does not appear to be present until the individual has reached a considerable size (No. 6). The immobile finger of young mature males and old mature males (Nos. 7, 8, 10, 12, 14) is swollen, and bears from 5 to 8 tubercles along the inner side of the cutting edge. The mobile finger of the same specimens is conspicuosly curved, and bears

TABLE V.—*Palaemon lanceifrons Dana var. montalbanensis var. nov.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Carapace length (posterior face of eye to posterior border of carapace).	Rostral formula.	Position of tip of rostrum with reference to tip of penduncle of first antenna.	First pair of legs (extension beyond antennal scale).	Extension of chelipeds beyond antennal scale.
1	♂	37.0	8.5	9/3	Slightly beyond	One-half of propodus	One-half of carpus.
2	♂	[a]49.5	13.0		do	do	Do.
3	♂	51.0	13.0	8/3	Slightly beyond	Propodus	Two-thirds of carpus.
4	♂	53.0	13.5	8/2	do	do	Most of carpus.
5	♂	57.0	14.0	8/3	One-half way between tip of rostrum and tip of peduncle.	do	Two-thirds of carpus.
6	♂	[b]59.0	15.5	8/3	do	One-fifth of carpus	Almost whole of carpus.
7	♂	58.0	16.0	8/2	Slightly behind tip of peduncle	Propodus	Distal end of merus.
8	♂	57.5	15.0	9/3	Even with tip	Tip of carpus	One-third of merus.
9	♂	60.5	16.0	9/2	Slightly beyond	Propodus	Most of carpus.
10	♂	[b]63.0	17.0	8/2	Even	Tip of carpus	One-third of merus.
11	♂	65.0	18.0	9/3	Slightly beyond	Propodus	Most of carpus.
12	♂	65.5	18.0	9/2	Slightly behind	Tip of carpus	One-third of left merus.
13	♂	69.5	18.0	9/3	Slightly beyond	Two-thirds of propodus	Most of carpus.
14	♂	[a b]70.0	19.0			Propodus beyond	One-third of merus.
15	♀	41.0	9.5	8/2	Slightly beyond	One-half of propodus	One-third of carpus.
16	♀	[c]46.0	11.0	10/2	do	do	Two-fifths of carpus.
17	♀	[c]51.5	11.5	9/3	do	do	Do.

[a] Estimated. Rostrum broken. [b] Right cheliped missing. [c] With eggs.

TABLE V.—*Palaemon lanceifrons Dana var. montalbanensis var. nov*—Continued.

No.	Sex.	Chelipeds.									
		Length of—						Total length beginning with ischium.	Gaping of fingers.	Felt on fingers.	Proportion of merus to carpus.
		Propodus.	Fingers.	Palm.	Carpus.	Merus.	Ischium.				
1	♂	L. 8.0	4.5	3.5	6.0	4.5	4.0	22.5	None	None	1.33
		R. 7.5	4.5	3.0	6.5	4.5	4.0	22.5			1.44
2	♂	L. 11.0	5.0	6.0	9.0	6.0	5.5	31.5	do	Slight on mobile finger	1.50
		R. 12.5	5.5	7.0	10.0	6.5	5.5	34.5			1.53
3	♂	L. 12.0	5.0	7.0	10.0	7.0	5.5	34.5	do	Considerable on mobile finger	1.43
		R. 13.0	5.5	7.5	10.0	7.0	5.5	35.5			1.43
4	♂	L. 15.5	7.0	8.5	12.5	8.0	6.0	42.0	do	Slight on mobile finger	1.56
		R. 14.0	6.0	8.0	11.5	7.5	6.0	39.0			1.53
5	♂	L. 13.5	6.0	7.5	11.0	8.0	6.0	38.5	do	do	1.37
		R. 14.0	6.0	8.0	12.0	8.0	6.0	40.0			1.50
6	♂	L. 19.5	9.0	10.5	15.0	10.0	8.0	52.5	do	Considerable on mobile and a little on immobile finger.	1.50
		R.									
7	♂	L. 26.0	10.0	16.0	21.0	13.0	8.0	68.0	Wide	Thick on both fingers	1.61
		R. 22.0	8.0	14.0	19.5	12.5	8.0	62.0			1.56
8	♂	L. 29.0	11.0	18.0	24.0	14.5	8.5	76.0	do	do	1.65
		R. 26.0	10.0	15.0	21.0	13.5	8.0	68.5			1.55
9	♂	L. 19.0	8.0	11.0	13.5	9.5	7.0	49.0	None	Considerable on mobile finger	1.42
		R. 16.5	7.0	9.5	12.5	8.5	7.0	44.5			1.47
10	♂	L. 33.5	12.5	21.0	25.0	15.5	10.0	84.0	Wide	Thick on both fingers	1.61
		R.									
11	♂	L. 20.5	9.5	11.0	16.0	11.0	8.0	55.0	None	Considerable on mobile finger	1.45
		R. 25.0	10.0	15.0	18.0	11.5	8.5	63.0			1.56
12	♂	L. 33.5	12.5	21.0	26.0	16.5	11.0	87.0	Wide	Thick on both fingers	1.57
		R. 26.5	11.0	15.5	23.0	15.0	10.5	75.0			1.53

13	♂	L. 25.0	10.0	15.0	19.0	12.5	10.0	66.5	Slight	Considerable on mobile and immobile fingers.	1.52
		R. 21.5	8.0	13.5	18.0	11.5	9.0	60.0			1.56
14	♂	L. 34.5	13.0	21.5	28.0	17.0	12.0	91.5	Wide	do	1.64
		R.									
15	♀	L. 7.0	3.5	3.5	6.5	4.5	4.0	22.0	None	None	1.22
		R. 7.0	3.5	3.5	6.5	4.5	4.0	22.0			1.22
16	♀	L. 9.0	4.0	5.0	6.5	5.0	5.0	25.5	do	do	1.30
		R. 9.0	4.0	5.0	7.0	5.0	5.0	26.0			1.40
17	♀	L. 9.0	4.5	4.5	7.5	5.0	5.0	26.5	do	do	1.50
		R. 8.5	4.0	4.5	7.5	5.0	5.0	26.0			1.50

from 2 to 4 tubercles along a similar region. These characters do not appear in young males, "mâles féminisés," nor females. The keel of the cutting edge of both fingers in young males and all females is well developed but low. It decreases in height as the body length increases, so that in the oldest males it is only a raised line. In the youngest males and females (Nos. 1 and 15) no teeth can be seen on the fingers, but slightly older specimens (Nos. 2 and 16) show 2 teeth on the mobile and 1 tooth on the immobile finger. The condition last mentioned is characteristic of all the females of this species in our collection, except of No. 15, but an examination of the older males shows the presence of confluent teeth back of the tooth, mentioned above, on the immobile finger. These teeth make their first appearance in No. 3, being represented by 1 or 2 very small teeth, but with increasing body length the number increases to 3 or 4.

The palm is cylindrical in cross section, that of one of the large males (No. 12) measuring 4 millimeters and that of a small male (No. 3) measuring almost 2 millimeters in diameter at the middle point.

The carpus is also cylindrical in cross section, and in females, young males, and "mâles féminisés" it increases in diameter passing from the distal to the proximal end. The same is true for young mature and old mature males, except that the greatest diameter is reached some distance posterior to the distal end. The carpus is shorter than the propodus and longer than the palm or the fingers; the palm, however, grows faster than the carpus.

The proportion of the merus to the carpus ranges from 1:1.33 in the smallest male to 1:1.64 in the largest, showing that the carpus increases in length faster than the merus. The latter is longer than the palm and is of the same length as the fingers in the smallest male and shorter than the palm and longer than the fingers in the largest. The merus, as in other species, is flattened dorsoventrally along the proximal part, becoming almost cylindrical and of greater diameter in the distal region.

Third, fourth, and fifth legs.—In the smallest male, the dactyli of the third and fourth legs and the tip of the propodus of the fifth leg extend beyond the antennal scale. The propodus of the fifth leg measures 5.5 millimeters in length and 0.1 millimeter in diameter at the middle region. One of the oldest males (No. 12) shows one-third of the propodus of the third and fourth legs beyond the tip of the antennal scale, while in the fifth leg one-fourth of the propodus is seen beyond. The propodus of

the fifth leg measures 10.5 millimeters in length, and has a width of 0.5 millimeter at its middle point.

Telson.—The telson of a large male has been described above. In young specimens the telson tip is subacute, the externolateral spines extend posteriorly almost as far as the telson tip, and the internolateral spines overreach the tip by more than two-thirds of their length.

Character of the surface.—The carapace and abdominal somites of all females (Nos. 15, 16, 17), "mâle féminisés" (Nos. 9, 11, 13), and young immature males (Nos. 1, 2, 3, 4, 5, 6) are smooth to the touch, and show no spines under a lens. Young mature males and old mature males (Nos. 7, 8, 10, 12, 14) have spines on the carapace, pleura of the abdomen, tergum of the sixth somite, the uropods, and the telson. The surface of the first pair of legs is smooth, except in the old males where the ischium presents a few feeble spinules. No spines can be seen on the chelipeds of the smallest male and female specimens (Nos. 1 and 15). Very minute and feeble spinules, which can only be seen under a rather high power lens, are present on the palm, carpus, and merus of specimens Nos. 2 and 16. The spines are more conspicuous in specimens Nos. 3 and 17. In the medium-sized and large males, the spines become better developed than in any of the females. Specimen 4 and all individuals of greater body length have spines on the ischium in addition to the spines on the palm, carpus, and merus. Specimens 7 to 14, inclusive, have also a few spines on the immobile finger. The spines in this species are not conspicuous, being broad, low, and subacute in old males. The "linear spaces" cannot be distinguished. There are very minute spines present on the merus, carpus, and propodus of the third, fourth, and fifth legs, but these can only be seen in the old males.

Eggs.—The eggs of this variety when preserved measure from 0.5 to 0.7 by 0.7 to 1 millimeter. Those *of P. lanceifrons* measure from 0.5 to 0.7 by 0.6 to 0.8 millimeter. The eggs of both are smaller than those of *Palaemon elegans* de Man, which measure 1 to 1.1 by 1.4 to 1.5 millimeters.

Color of the living specimens.—The color of the general surface of the body is similar to that of *Palaemon lanceifrons* Dana. The pigment marks which are so characteristic of the carapace of the latter are plainly seen.

Localities.—There are 37 males and 35 females of this variety in our collection; all of them were collected below the dam at Montalban near Manila.

Palaemon lar Fabricius. Plate II, figs. 7 and 7*a-h*.

The widely distributed *Palaemon lar* Fabricius is represented in our collection by a large number of specimens, most of which were collected in Mindoro.

Rostrum and penduncle of the first antenna.—The rostrum in our specimens usually extends to a point slightly beyond or slightly behind the tip of the peduncle of the first antenna, but in one case it reaches to the tip of the antennal scale. In males possessing mature characters (chelipeds longer than the body and fingers gaping widely and with heavy teeth) the rostrum does not extend as far forward with reference to the tip of the antennal scale as in the younger, immature individuals.

Curvature and dental formula of rostrum.—In the youngest specimens the tip of the rostrum is straight and there is almost no convexity of the dorsal border of the rostrum, but older specimens show a slight upward curve of the tip and a gentle convexity over the eye. The first 2 rostral teeth are found on the carapace, and usually are separated from one another by a greater distance than are those farther forward. Frequently, the third tooth lies partly on the carapace. The lateral ridge on the rostrum divides the surface into an upper wider and a lower narrower region. The number of teeth does not vary through a very great range, the dental formula being $\frac{7,\ 8}{2,\ 3,\ 4}$.

First pair of legs.—The whole of the propodus extends beyond the tip of the antennal scale in all the specimens, and in most individuals this distance is increased by from one-fifth to one-third of the carpus.

Chelipeds.—The chelipeds of immature specimens are approximately equal in length except in cases where one cheliped is regenerating. Some of the mature males have chelipeds which are about equal in length, but as a rule there is considerable inequality. Here again, as in many other palaemons, it is impossible to determine from preserved specimens whether the inequality is the result of injury or whether it is a normal, characteristic condition. An interesting case is shown in Plate II, fig. 7*b*, where one of the chelipeds is considerably longer than the other but the palm of the former has a smaller diameter and the fingers are more weakly developed. Our collection does not include the oldest mature males which may attain a body length of almost 200 millimeters. Specimens 10 and 13 are young mature males, and their chelipeds are longer than the body. The younger immature males, the "mâles féminisés" (No. 12, Table VI), and the

females have chelipeds which are shorter than the body. In the youngest individuals, as a rule, the propodus and part of the carpus extend beyond the antennal scale, with increasing size the tip of the merus is seen beyond, and finally in the largest of our males from one-third to one-half of the merus overreaches the scale.

The fingers of all individuals of this species in our collection are shorter than the palm, in the young they are only slightly shorter, but in the largest specimens the length of the fingers is contained one and one-half times or more in the length of the palm. A few stiff hairs are present on the fingers, but there is no dense felt such as is seen in some other species. Young males, "mâles féminisés," and all the females show no gaping of the fingers, but in the old males the gape is very wide and the immobile finger extends a little beyond the mobile finger. There is no keel on the cutting edge of the fingers in the old males, but in other individuals it is present. Four or 5 small proximal teeth and 1 larger distal tooth are seen on the mobile finger of young males, "mâles féminisés," and all females, but in mature males the smaller teeth become reduced to 2 or 3 long inconspicuous tubercles and the large tooth becomes very much larger. On the immobile finger 1 tooth is present in the youngest males and females, but in older individuals (Nos. 7 to 13, inclusive) a second smaller and proximal tooth appears. These 2 teeth are well developed in the old males (figs. 7*a* and 7*b*).

The palm of the oldest males is almost cylindrical in cross section, but in younger individuals it is flattened laterally.

The carpus of young individuals is almost as long as the palm and longer than the fingers, but with increasing body length the palm becomes much longer than the carpus and even the fingers show a greater length than the latter. The cylindrical carpus is much wider at its distal than at its proximal end.

The merus is always longer than the carpus or the fingers. It is equal in length to the palm in young individuals, but much shorter in old specimens. The proportion of the merus to the carpus is very constant, varying from 1:0.75 to 1:0.93. The merus is flattened dorsoventrally at its proximal end, and in old individuals is much enlarged at its distal end.

Third, fourth, and fifth legs.—The tip of the dactylus of the third pair of legs extends slightly beyond the tip of the antennal scale in young specimens (No. 2). The dactylus of the fourth pair of legs fails to reach the tip of the scale by a short distance, and the dactylus of the fifth pair of legs extends slightly beyond the end of the carpus of the chelipeds. The propodus of the

TABLE VI.—*Palaemon lar Fabricius.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Carapace length (posterior face of eye to posterior border of carapace).	Rostral formula.	Position of tip of rostrum with reference to tip of peduncle of first antenna.	First pair of legs. Extension beyond antennal scale.	Extension beyond antennal scale.	Chelipeds. Length of— Propodus.	Fingers.	Palm.	Carpus.	Merus.	Ischium.	Total length, beginning with ischium.	Gaping of fingers.	Hairs on fingers.	Proportion of merus to carpus. Left cheliped excepting No. 14.
1	♂	55.0	15.0	7/2	Slightly behind	Tip of carpus	L. one-half of carpus.	12.0	5.0	7.0	6.5	7.0	6.5	32.0		Sparsely hairy.	0.93
							R. two-fifths of carpus.	11.0	5.0	6.0	5.5	6.5	6.0	29.0	None		
2	♂	64.0	16.5	8/4	Even with tip of antennal scale.	do	L. one-third of carpus.	14.5	7.0	7.5	7.0	7.5	7.5	36.5			0.93
							R. one-third of carpus.	14.0	6.5	7.5	7.0	7.5	7.5	36.0	do	do	
3	♂	70.0	18.5	7/3	Slightly behind	do	L. four-fifths of palm.	13.0	6.0	7.0	6.0	8.0	7.0	34.0			0.75
							R. palm	14.5	7.0	7.5	6.0	8.0	7.0	35.5	do	do	
4	♂	71.0	19.0	8/2	do	One-third of carpus.	L. one-half of carpus.	17.5	8.5	9.0	7.0	9.0	7.0	40.5			0.78
							R. three-fifths of carpus.	19.0	9.0	10.0	8.0	9.5	8.0	44.5	do	do	

5	♂	78.0	20.0	8/3	Even with tip of antennal scale.	Propodus	L. one-third of carpus.	19.0	9.0	10.0	9.1	10.0	9.0	47.1	do	do	0.91
							R. two-fifths of carpus.	19.5	9.0	10.5	10.0	10.0	9.0	48.5			
6	♂	92.5	27.0	(a)	Even with tip of peduncle.	One-fourth of carpus.	L. four-fifths of carpus.	33.5	15.5	18.0	14.0	16.0	12.0	75.5	do	do	0.87
							R. four-fifths of carpus.	33.0	15.0	18.0	13.0	16.0	12.0	74.0			
7	♂	94.0	26.5	8/2	do	One-fifth of carpus.	L. tip of merus	40.5	16.5	24.0	14.9	17.0	12.0	84.4	Slight	do	0.88
							do	40.5	16.5	24.0	15.0	17.5	12.0	85.0			
8	♂	103.0	29.5	8/3	do	One-sixth of carpus.	L. carpus	45.0	19.0	26.0	16.0	18.5	13.0	92.5	Very slight	do	0.87
							R. almost whole of carpus.	43.0	18.0	25.0	16.0	19.0	13.5	91.5			
9	♂	106.0	32.0	8/4	do	do	L. tip of merus	46.0	19.0	27.0	18.0	21.0	14.0	99.0	do	do	0.86
							R. five-sixths of carpus.	38.0	16.0	22.0	16.0	18.0	13.0	85.0			
10	♂	114.0	35.0	7 3	do	One-third of carpus.	L. two-fifths of merus.	81.0	35.0	46.0	27.0	32.0	18.0	158.0	Gape very wide [b]	do	0.84
							R. one-third of merus.	82.5	36.5	46.0	25.0	28.5	17.0	153.0			
11	♂	118.0	36.0	8/2	Fails to reach tip of peduncle.	Propodus	L. carpus	49.5	21.0	28.5	20.0	22.0	15.0	106.5	L. very slight. R. slight	do	0.91
							R. tip of merus	58.0	25.0	33.0	19.0	22.5	15.0	114.5			
12	♂	121.0	33.0	7/3	Slightly beyond	One-fifth of carpus.	L. carpus	41.0	18.0	23.0	18.0	20.5	14.5	94.0	None	do	0.88
							R. carpus	40.5	17.5	23.0	17.5	21.0	15.0	94.0			
13	♂	127.0	39.0	7/3	Even	One-third of carpus.	L. two-fifths of merus.	[c]102.0	41.0	61.0	30.5	35.5	20.5	188.5	Wide	do	0.86
							R. one-half of merus.	[c]88.5	35.0	53.5	32.0	38.0	21.0	179.5			
14	♀	125.0	34.5	8/2	Even with tip of antennal scale.	Tip of carpus	(d)										
							R. one-half of carpus.	33.0	15.0	18.0	13.0	16.0	13.0	75.0	None	do	0.81

[a] Abnormal.

[b] Gape especially wide between fingers of right cheliped. Palm of right cheliped much wider than that of left cheliped.

[c] Estimated. Fingers broken.

[d] Left cheliped missing.

right fifth leg measures 0.5 millimeter in diameter at its middle point, and is 7 millimeters long. In old specimens (No. 13) the tip of the dactylus of the third leg extends slightly beyond the antennal scale, the tip of the dactylus of the fourth leg fails slightly to reach the tip of the scale, and one-fifth of the propodus of the fifth leg extends beyond the tip of the peduncle of the second antenna. The diameter of the propodus of the right fifth leg at the middle point is 1.5 millimeters, and its length is 17 millimeters.

Telson.—The tip of the telson (specimen 81 millimeters long and not listed in the table) is subacute, the externolateral spines fail by their own length to reach the level of the telson tip, and the internolateral spines extend with three-fifths of their entire length beyond the tip of the telson.

Character of the surface.—All specimens of *Palaemon lar* in our collection have smooth bodies. Even the largest males show no signs of the patches of spines which are found on the carapace, pleura of the abdominal somites, tergum of the sixth somite, uropods, and telson of mature males in some other species. The first legs are smooth in small specimens, but in medium-sized and large individuals the ischium is armed with short, heavy, inconspicuous spines. The chelipeds are well supplied with strongly developed subacute spines, which are arranged in rather definite longitudinal lines. These spines are found on all segments, and those on the inner side are the largest. Two sets of "linear spaces" can be distinguished in all middle-sized and large specimens. One set is found on the outer lateral surface of the palm, carpus, and merus, the other is found along the ventral surface of the same segments. The third, fourth, and fifth legs of young individuals have well-developed spines on the propodus, but the remaining segments are smooth. With increasing size more of the segments become spiny, until in the old males with mature chelipeds the dactylus, propodus, carpus, merus, and ischium have a coating of spines.

Eggs.—The average size of the preserved eggs of the single female specimen is 0.5 by 0.6 millimeter.

Color of the living specimen.—The carapace, abdomen, and telson of the male vary in color, being grayish brown, olive, or very dark blue. The uropods are usually olive or dark blue, with reddish brown around the edges. Very distinct orange-colored spots are seen on the sides of the abdomen at the junctions of the terga and pleura, except in the case of the third segment. There are no T- or L-shaped markings on the carapace. The first pair of legs is blue, tinged in places with pink; the

chelipeds are olive to a very dark blue, and show in places brown mottled markings; and the walking legs show a mixture of gray, blue, and brown. The color of the female is similar to that of the male, except that the ventral edges of the pleura are of a cream color. The colors are brighter in young than in old individuals.

Localities.—The collection contains 96 males and 1 female from Port Galera, Mindoro, 1 male from the settling basin of the Manila water works near San Juan del Monte, Luzon, Philippine Islands, and 5 males from Guam, Mariana Islands. The single specimen from the settling basin was collected by A. L. Day, and those from Guam by R. C. McGregor.

Palaemon jaroensis sp. nov. Plate III, figs. 8 and 8*a-k*.

The work of Coutière [40a] on *Palaemon lepidactylus* Hilgendorf and that of von Martens [41] on *Palaemon grandimanus* Randall indicate that there may be striking differences in the shape and proportion of the chela in a given species. The variability, especially of the former species, renders it difficult to determine whether or not one is dealing with a new species when examining specimens which are quite similar in certain respects to *Palaemon lepidactylus*, but which come from new localities.

The individuals of one series of specimens in our collection, although not showing much variability, remind one of *Palaemon lepidactylus* Hilgendorf.[42] After a careful examination I have decided that they belong to a new and distinct species which is closely related to *Palaemon placidus* de Man,[43] *Palaemon hilgendorfi* H. Coutière, and *Palaemon lepidactylus* Hilgendorf. This species to which I have given the name *Palaemon jaroensis* is represented in our collection by 23 specimens, of which 6 males and 2 females are perfect so far as the chelipeds are concerned. While there is considerable difference between the chelipeds of the females and those of the males, this is probably sexual. There is but little variability in the shape, proportions, and other characteristics of the large cheliped of the male specimens, and the same is true of the small cheliped, but there is a constant difference in the proportional length of the segments of the large cheliped when compared with those of the small cheliped of the same individual.

[40a] *Ann. Sci. Nat., Zool.* (1900), 11, 272.
[41] *Arch. f. Naturgesch.* (1868), 34, 45.
[42] *Monatsber. Preussischen Akad. d. Wissensch.* Berlin (1879), 838.
[43] Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien (1892), 2, 483.

TABLE VII.—*Palaemon jaroensis sp. nov.*

No.	Sex.	Body length (tip of rostrum to tip of telson).	Carapace length (posterior face of eye to posterior border of carapace).	Rostral formula.	Position of tip of rostrum with reference to tip of peduncle of first antenna.	First pair of legs (extension beyond antennal scale).	Chelipeds.											
							Length of—					Length of—						
							Propodus.	Fingers.	Palm.	Width of palm.	Thickness of palm.	Carpus.	Merus.	Ischium.	Total length beginning with ischium.	Gaping of fingers.	Hair on fingers.	Proportion of merus to carpus.
1	♂	65.0	21.0	12/2	Fails to reach end of peduncle	Three-fifths of carpus	R. 42.5	21.0	21.5	10.0	7.0	20.0	17.0	9.0	88.5	Wide	Thick	1.17
							L. 28.0	16.0	12.0	6.5	5.0	14.5	12.5	8.5	63.5	do	do	1.16
2	♂	65.0	21.0	11/2	do	do	R. 42.0	20.0	22.0	10.0	7.0	20.0	17.0	9.0	88.0	do	do	1.17
							L. 28.0	15.0	13.0	7.0	5.0	15.0	13.0	8.5	64.5	do	do	1.15
3	♂	67.0	22.0	11/2	do	Two-fifths of carpus	R. 42.5	19.0	23.5	10.5	8.0	20.0	17.0	9.0	88.5	do	do	1.17
							L. 26.5	14.5	12.0	6.5	5.0	14.5	13.0	8.5	62.5	do	do	1.11
4	♂	[a]67.0	22.0	12/2	do	do	R. 23.0	13.0	11.0	6.0	4.0	13.0	12.0	7.0	55.0	do	do	1.08
							L. 41.5	20.0	21.5	10.0	7.0	19.0	17.0	9.0	86.5	do	do	1.11
5	♂	[a]69.0	22.5	12/2	do	do	R. 37.0	19.0	18.0	8.0	6.0	19.0	17.0	9.5	82.5	do	do	1.11
							L. 20.5	11.0	9.5	5.0	3.5	11.0	10.0	7.0	48.5	do	do	1.10
6	♂	72.0	22.0	11/2	do	do	R. 30.0	15.5	14.5	7.5	5.0	15.0	13.0	8.0	65.5	do	do	1.15
							L. 46.0	21.0	25.0	11.5	8.5	21.0	19.0	10.0	96.0	do	do	1.10
7	♀	60.0	16.5	11/2	do	Three-fifths of carpus	R. 15.0	8.0	7.0	3.5	3.0	9.0	7.0	7.0	38.0	None	(b)	1.28
							L. 12.5	7.0	5.5	3.0	2.5	8.0	7.0	6.5	34.0	do	(b)	1.14
8	♀	[c]62.0	18.0	11/2	do	do	R. 16.0	7.0	9.0	3.0	2.0	9.0	8.5	7.0	40.5	do	(b)	1.05
							L. 16.0	7.0	9.0	3.0	2.5	9.0	9.0	7.0	41.0	do	(b)	1.00

[a] Estimated. Telson broken.

[b] Thick hair absent.

[c] Estimated. Rostrum broken.

The following description applies to the largest male (No. 6, Table VII), which is 72 millimeters long. The rostrum almost reaches the tip of the peduncle of the first antenna and has the formula $\frac{11}{2}$. It is convex over the eye, dipping sharply anteriorly and then extending horizontally at the tip. The teeth on the carapace are more widely separated than those immediately anterior to them, and the first one is situated a little more than two-thirds of the distance from the posterior edge of the carapace to the border of the orbit.

The first pair of legs extends with two-fifths of the carpus beyond the antennal scale.

The chelipeds are decidedly unequal in size and length but similar in shape, a condition which is found in all the males of *P. javoensis* in our collection and one which may be characteristic of all middle-aged and old males of this species. In the case of the larger cheliped, which measures 96 millimeters in length, one-third of the merus extends beyond the antennal scale. The mobile finger curves sharply, while the immobile finger is practically straight, and when their tips meet a considerable space is seen between them. Along the proximal portion of the cutting edge of the immobile finger are 6 blunt, fairly well-developed teeth which are not situated upon a raised ridge. The 4 nearest the palm are confluent. Following the 6 teeth is a space, and distal to this is a series of 11 blunt teeth arranged at rather regular intervals along the cutting edge and extending almost to the tip of the finger. The most proximal one of these is larger than the rest. A series of 9 similar teeth are present along the inner side of the cutting edge, but the teeth are not upon the latter. There is no large tooth corresponding to the one on the cutting edge. The toothing on the mobile finger consists of 3 rather large, blunt, irregular, proximal teeth and 2 distal series of smaller blunt teeth separated from the former by a space. As in the case of the immobile finger, the outer teeth are found on the cutting edge while the inner are not. There are 10 of the former and 8 of the latter, and there is no conspicuously large tooth at the beginning of either series.[44]

[44] An examination of the fingers on the large cheliped of smaller specimens shows that the dentition is similar, but that the number of teeth in the two series beyond the space may be much smaller, especially along the inner side of the finger, and that there is some variation in the number of proximal teeth. In the females very small proximal teeth are present and the keel of the cutting edge is well developed, but the proximal series of blunt teeth, so characteristic of the males, is not present on the fingers of either cheliped.

A thick growth of rather short hairs is present along the cutting edge of both fingers, and as a result the teeth described above are completely concealed.

The much flattened palm (11.5 millimeters wide and 8.5 millimeters thick) is longer than the fingers, the proportion of the length of the fingers to that of the palm being 1:1.19; the slightly flattened carpus which is smaller in diameter and shorter than the palm equals the fingers in length; and the merus is shorter than the carpus,[45] a condition which seems to be characteristic of *Palaemon placidus,* but not of *Palaemon hilgendorfi* or *Palaemon lepidactylus.*

The smaller cheliped measures 65.5 millimeters in length, and the distal end of the merus just reaches the tip of the antennal scale. It is similar in appearance to the large cheliped, but the relative lengths of the different segments are not the same. As in the case of the large cheliped the fingers gape, the mobile one curving rather sharply and the immobile one being practically straight. The dentition of the fingers is similar to that of the fingers of the large cheliped, except that the distal series of teeth along the inner side of each finger is made up of a smaller number of teeth and that there are 8 proximal teeth on the immobile finger instead of 6. The cutting edge of each finger is clothed with a heavy coat of short hairs which conceals the teeth.

The fingers (15.5 millimeters) are longer than the palm (14.5 millimeters), and this is true for the small cheliped of all the male specimens. The palm is flattened, and measures, at its widest point, 7.5 millimeters in width and 5 millimeters in thickness. The carpus is slightly longer than the palm, and the same is true for these 2 segments in the small cheliped of all the male specimens. As in the large cheliped the merus is shorter than the carpus.

The impression one receives from comparing the large and small chelipeds of the same individual is that the smaller is merely a younger stage in the development of the larger, that if the specimen had lived and molted the palm of the former would have increased in length at a faster rate than the carpus, and that finally the small cheliped would have assumed the form, size, proportions, and general characteristics of the larger cheliped. It is impossible to determine, however, with the specimens

[45] All the males of this species in our collection show a similar condition, but in the females the carpus and merus are about equal, and it is probable that the latter is true of young males.

at hand if the two chelipeds ever become more nearly alike in older individuals.

The tip of the telson is acute, but the lateral spines are worn, and some of them are absent from the specimen under consideration. In another male specimen with a more perfect telson the externolateral spines are very short and the internolateral spines extend beyond the tip of the telson with one-half of their length.

The carpus, abdominal segments, and uropods are smooth, but the second, third, fourth, and fifth legs are well covered with heavy spines. In general, the spines are much like those of *Palaemon lepidactylus* Hilgendorf, except that there are no conical spines on the superior [45a] and inner surfaces of the palm of the cheliped and that in the place of these there are pointed, flattened spines, whose upper surfaces are concave and whose lower surfaces are convex. Also, these spines are found on the fingers as in the case of *Palaemon lepidactylus* Hilgendorf. "Linear spaces" are present on the palm, carpus, and merus of both chelipeds.

The third, fourth, and fifth legs are stout in comparison with those of most other palaemons. There is little difference in the length of these legs; the fifth is the shortest. One-third of the propodus of the third leg and the tip of the dactylus of the fourth leg extend beyond the tip of the antennal scale, but the fifth leg extends only slightly beyond the tip of the peduncle of the second antenna. The propodus of the fifth leg measures 9 millimeters in length and 1.1 millimeters in diameter at its middle point.

The two females listed in Table VII are the only perfect ones in the collection. The right and left chelipeds in each specimen are nearly the same in size and shape. No distal teeth are present, but there is a well-developed keel on the cutting edge of both fingers, and this keel is partially concealed by a sparse growth of hair. One female, which is not listed in Table VII, carries eggs, and the measurements of these average 0.7 by 0.5 millimeter.

The 18 males and 5 females of this new species were taken in Hibucawan River, near Jaro, Leyte, by Alvin Seale and Urbano Villamor.

Palaemon lepidactylus Hilgendorf. Plate III, figs. 9 and 9*a-b*.

A rare species known as *Palaemon lepidactylus* Hilgendorf is represented in our collection by 2 male specimens. Both individuals are rather small, and one has the chelipeds missing; the

[45a] That is, the border which is continuous with the immobile finger.

uninjured individual has these appendages well developed. The body length of the latter is 58.5 millimeters and the carapace length, 18.5 millimeters; the other has a body length of 66 millimeters and a carapace length of 20 millimeters. The following description applies to the smaller specimen:

The rostrum extends slightly beyond the middle segment of the peduncle of the first antenna, and the first tooth on the dorsal border is 7 millimeters posterior to the anterior edge of the carapace. Five teeth are situated on the carapace, and these are more widely separated from one another than those anterior to them. The dorsal border dips anteriorly, showing only a slight convexity over the eye. The lateral ridges of the rostrum divide the lateral surface into an upper, wider region and a lower, narrower region. The dental formula of the specimen under consideration is $\frac{13}{2}$, while that of the other is $\frac{12}{2}$.

Three-fifths of the carpus of the first pair of legs extends beyond the tip of the antennal scale.

The chelipeds are decidedly unequal in length and different in form, the larger being much longer than the body. One-half of the merus of the larger (left) and one-fifth of the merus of the smaller extend beyond the antennal scale. The slightly gaping fingers of the large cheliped are much longer than the palm, the length of the mobile finger being 25 millimeters and that of the palm 16 millimeters. The toothing of the fingers agrees well with Coutière's description and figures. At the proximal end of the immobile finger close to the articulation of the mobile finger with the palm are 4 rather indefinite teeth on a short ridge, which is a continuation of the cutting edge. Following this is a short space along the cutting edge which is without teeth. At the end of the space is a well-developed obtuse tooth, beyond which a distinct keel is seen extending to the tip of the finger. Along the inner side of this keel, but not arising from it, is a series of 16 anteriorly directed, acute teeth which are placed at somewhat regular intervals. On the outer side of the keel is another series of 14 teeth similar to the one just mentioned, but the teeth have their origin from the side of the keel. At the proximal end of the mobile finger are 3 blunt teeth, the posterior 2 of which meet the short raised ridge of the immobile finger. The mobile finger extends beyond the immobile finger.

The oval palm, which is much wider than the carpus, measures 16.5 millimeters in length, 10.5 millimeters in width, and 6 millimeters in thickness. The carpus (17 millimeters) is slightly

longer than the palm, and is much reduced in diameter at its posterior end. The merus equals the carpus in length, while the ischium measures 8.5 millimeters.

A "linear space" is seen along the outer surface of the merus, carpus, and palm. The spines on the posterior, outer region of the palm are scalelike and oval in shape, and each spine is rather closely applied to the palm. Toward the anterior end of the palm the spines become more pointed, and on the fingers they curve at the tip, their upper surfaces being decidedly concave and their lower surfaces convex. On the superior border of the palm (the border continuous with the immobile finger) are 2 rows of stout conical spines, and these spines are longer than any of the others. Similar shorter spines are distributed sparsely over the inferior inner surface of the palm, and these, toward the superior region, grade into spines like those of the outer surface of the palm. Smaller spines of similar shape and distribution to those of the palm are found on the carpus, merus, and ischium.

The smaller cheliped (right) has slender widely gaping fingers, the mobile one of which measures 15.5 millimeters in length. Along the cutting edge of each finger is a dense growth of stiff hairs, but no teeth, tubercles, or keel can be seen.

The short oval palm measures 7 millimeters in length, 6 millimeters in width, and 4 millimeters in thickness. The carpus is not so wide (5 millimeters) as the palm, but is somewhat longer (9 millimeters). The merus (11 millimeters) is considerably longer than the carpus, and the ischium measures 6 millimeters.

The spines are much smaller than those of the larger cheliped, but they have a similar shape and distribution. "Linear spaces" are present. Patches of spines, which are characteristic of supposedly mature individuals in many species of palaemons and which are found on the carapace and abdomen, are not present in our two specimens.

In each specimen the tip of the telson is truncated, but this is probably the result of wear. The internolateral spines extend beyond the tip of the telson, a condition which is undoubtedly true of uninjured specimens. As usual, the externolateral spines are short. The inner ramus of the uropods extends posteriorly slightly farther than the outer ramus.

The third, fourth, and fifth legs are rather stout as compared with most other species of palaemons. The fifth leg is the shortest and the slenderest, although there is but little difference between the three. One-half of the propodus of the third leg

and the tip of the dactylus of the fourth leg extend beyond the tip of the antennal scale, but the fifth leg barely reaches it. The propodus of the fifth leg measures 7 millimeters in length, and at its middle point it is 1 millimeter in thickness.

Both specimens are males; they were collected in a small mountain stream near Sisiman, Bataan Province, Luzon, by Tomas Banguis.

Palaemon latidactylus Thallwitz. Plate III, figs. 10 and 10*a-h*.

This species is represented in our collection by 2 young mature male specimens (Nos. 1087 and 1484)[46] from the region of Manila, which agree very well with Thallwitz's[47] original description and with the description of de Man.[48] There are also 2 male specimens (Nos. 73 and 128), collected in the region of Manila, which I believe belong to the same species but which I consider to be "mâles féminisés;" 2 females (Nos. 371 and 593) from the Manila water supply; 1 male (No. 1485) from the Manila water supply, which I hesitate to include under this species; 2 specimens (Nos. 1499 and 1500), one of which is an old male and the other a young male from Jaro, Leyte; 3 specimens (No. 1451) from Agusan River, Mindanao; and a young mature male (No. 71) from Samar, which differs only slightly from Thallwitz's original description.

I believe, as do Thallwitz and de Man, that the specimens from Manila diagnosed by von Martens[49] as *Palaemon grandimanus* Randall are probably identical with *Palaemon latidactylus* Thallwitz. On the other hand, it is very questionable if von Martens's Manila specimens belong to Randall's *Palaemon grandimanus*. Miss Rathbun's notes on Randall's type specimens and her photographic reproduction of an old male from the Honolulu market indicate that von Martens's Manila specimens belong to a different species.[50] The following description applies to an old male (No. 1484) collected from the settling basin of the Manila water supply:

It is 66 millimeters in length (carapace 20.5 millimeters), and the rostrum extends to the tip of the peduncle of the first antenna. There are 16 teeth on the dorsal border of the rostrum,

[46] In this description the numbers referred to are museum numbers.

[47] Abhandlungen und Berichte des Königlichen Museums zu Dresden (1891), 17.

[48] *Abh. Senckenbergischen Naturforsch. Ges.* (1900), 25, 802.

[49] *Arch. f. Naturgesch.* (1868), 34, 45.

[50] *Bull. U. S. Fish Comm.* (1903), 23, pt. 3, 923. Published in 1906.

of which 4 are situated on the carapace. The first and second teeth, and in some other specimens also the second and third, are more widely separated from one another than the rest. Anteriorly the dorsal border dips, but there is scarcely any convexity over the eye. On the lower border are 3 teeth, sometimes 4 in other specimens, and the tip of the rostrum does not turn upward. The posterior part of the lateral ridge on the rostrum should be shown slightly higher up than it is in the figure (Plate III, fig. 8). One-sixth of the carpus of the first pair of legs extends beyond the antennal scale, and the outer maxillipeds reach slightly beyond the peduncle of the second antenna.

The chelipeds are decidedly unlike in form and unequal in length, the larger being much longer than the body. One-sixth of the merus of the larger and one-third of the carpus of the smaller cheliped extend beyond the antennal scale. Measuring in a straight line from the articulation of the mobile finger (large cheliped) to the tip of the same, the length is 20 millimeters. This finger is strongly curved inward, it is compressed laterally throughout its extent, and crosses the tip of the immobile finger when the fingers are closed. Near the proximal end of the mobile finger, along the cutting edge, are 3 small, closely set teeth, which are followed distally by 2 somewhat larger teeth. Beyond these, 5 teeth are seen which gradually decrease in size, until near the tip the last one is nothing more than an inconspicuous tubercle. The immobile finger is strongly compressed laterally, its outer surface is decidedly concave near the palm, and its proximal end is much wider than that of the mobile finger, about 2:1. Near the proximal end of the cutting edge is a comparatively large tooth, which curves inward ending in an acute tip. This is followed by 7 smaller teeth, which become almost like tubercles near the tip of the finger. A few scattered hairs may be seen on both fingers, but at the proximal end of the mobile finger and on its lower surface there is a small dense patch of hairs.

The palm, which is strongly compressed, measures 30 millimeters in length, 12.5 millimeters in width at its widest point, and 6.5 millimeters in thickness in the same region. From these figures it will be seen that the palm is one and one-half times as long as the finger and that the ratio of the thickness of the palm to the greatest width is about 1:2.

The carpus, which is practically cylindrical in cross section and much narrower than the palm at its distal end, measures 25.5 millimeters in length, thus being shorter than the palm.

The merus varies in the shape of its cross section at different points, and measures 19 millimeters in length. It is much longer than the greatly compressed ischium, which is only 7.5 millimeters along its longest border.

There is a considerable growth of hair on the ventral edge of the palm and ischium. A few hairs are found near the ends of the carpus and merus, but for the most part the palm, carpus, merus, and ischium are without hairs. Closely set sharp spines are present on the inferior and lateral surfaces of the proximal end of the mobile finger, but the remainder of the finger is smooth. Similar closely set spines are present on the inferior border of the palm. These grade into much smaller and more widely separated teeth on the inner surface and, on the outer surface, into widely separated, very minute spines. A few rather heavy spines are located along the outer surface of the anterior border of the palm, where the mobile finger articulates. The spines on the carpus are widely separated, and on the inner surface they are fairly well developed. There are practically no spines on the upper and outer surfaces of the merus and ischium, but on the lower and inner surfaces they are very close set and well developed.

"Linear spaces" cannot be seen, but a longitudinal depression on the outer and inner surfaces of the palm along a line connecting the articulation of the mobile finger with the proximal end of the palm is very conspicuous.

The smaller cheliped (left) has slender, widely gaping fingers; the mobile one measures 12 millimeters in length, and the immobile one is slightly shorter. Along the cutting edge of both fingers is a dense growth of stiff hairs and a well-developed keel. Near the proximal end of the immobile finger is a short portion of the cutting edge, which shows indication of breaking up into 3 or 4 teeth. This is followed distally by a short space at the end of which is a small tooth, but beyond the latter no teeth nor tubercles can be seen. Three small teeth are visible at the proximal end of the mobile finger. The short oval palm measures 7.5 millimeters in length, 4.5 millimeters in width, and 3.1 millimeters in thickness. The carpus is not so wide (4 millimeters) as the palm, but it is considerably longer (10 millimeters). The merus (9.5 millimeters) is slightly shorter than the carpus, and the ischium measures only 6 millimeters in length.

Unlike the larger cheliped, the fingers, palm, and carpus are free from spines, but the lower surface of the merus and ischium are armed with a few spines similar to those on the large cheliped, but smaller. Patches of small spines are present on the anterior

part of the carapace in the dorsal and lateral regions, but they are not present on the abdomen nor on its appendages.

The telson ends in an acute spine; the externolateral spines do not extend so far posteriorly as the tip of the telson, but the internolateral spines overreach it by one-half of their length. The 2 rami of the uropods extend the same distance posteriorly.

Some of the walking legs of this specimen are missing, but in the other old male (No. 1087) they are intact. In the case of No. 1087, the third, fourth, and fifth legs are of equal length but slenderer than those of *Palaemon lepidactylus*. The third leg just reaches the tip of the antennal scale. One-fifth of the propodus of the fourth leg and the dactylus of the fifth leg extend beyond the peduncle of the second antenna. The propodus of the fifth leg measures 8.75 millimeters in length, and at its middle point it is 0.5 millimeter in diameter.

The old male, No. 1484, which has been described in detail above, was collected in the settling basin of the Manila water supply by A. L. Day; the old male, No. 1087, was collected by Alvin Seale from Laguna de Bay, near Manila, Luzon.

Two other male specimens, Nos. 128 and 73, collected in the region of Manila, differ in the size of the body and the form of the large cheliped from the individual described above. These specimens have a somewhat greater body length, the gape between the fingers of the chela is less, the mobile finger is not curved so sharply, the width of the immobile finger at the proximal end (Plate III, figs. 10*c* and 10*d* for No. 128 and No. 73, respectively) is not so great, and there is a more extensive armature of spines on the outer surface of the palm. I consider these specimens, although they are larger than the young mature males, to be "mâles fémenisés" or at least specimens in which the mature male form of the chela has not yet developed. Unlike No. 1484, the patches of spines on the carapace are feebly developed, a condition which indicates immaturity.

The 3 specimens (No. 1451) from Mindanao are very similar to the young mature male. They have about the same body length (one specimen is a little smaller), and the large chela (Plate III, fig. 10*e*, No. 1451x) is still well armed with spines on the outer surface, but it is approaching more nearly the shape and proportions of the mature male form. The specimen (No. 71) from Samar is smaller than the specimens from Mindanao, but the large chela has taken on the mature form and proportions. I consider it to be a young mature male.

One of the specimens from Leyte (No. 1500) measures 86.5 millimeters in length (carapace, 27 millimeters). It is an old

mature male and the largest one in the collection. Unfortunately, the fingers on the large cheliped are broken. The palm measures 35 millimeters in length, 15 millimeters in width, and 8 millimeters in thickness, indicating that with increasing age the palm becomes wider in proportion to the length (1 : 2.33) and thicker in proportion to the width (1:1.80). The patches of spines on the carapace are better developed than in any of the rest of our specimens, but as in the latter they are absent from the abdomen. The superior portion of the outer surface of the palm is absolutely smooth.

The other specimen from Leyte (No. 1499) is of interest because it is a very young male, possibly a "mâle féminisés." Anteriorly, the rostrum dips only slightly, and there are no patches of spines on the carapace or abdomen. The large chela is similar in shape to that of specimen 128, but it is smaller. The palm is well covered with fine spines, and the gape between the fingers is small. There is no gape between the fingers of the small chela and no thick growth of hair. Furthermore, the slender fingers are only slightly longer than the narrow palm, which is no wider than the carpus.

The largest female, No. 593, measures 68 millimeters in body length, the carapace and abdomen are smooth, and the chelipeds are alike. There is no gape between the fingers which lack a thick growth of hair and no teeth on the distal two-thirds, but there is a well-developed keel on the cutting edge of the latter. The fingers are shorter than the palm, which is compressed and slightly wider than the carpus.

Finally, specimen 1485, an old male from the water supply of the city of Manila, is one which, owing to lack of material, I do not feel justified in classifying at the present time. It measures 91 millimeters in body length, dense patches of spines are present on the anterior part of the carapace, the abdomen is smooth, and the rostrum is practically like that of *Palaemon latidactylus*. The large cheliped in respect to the distribution of spines and the toothing of the fingers is like that of *Palaemon latidactylus*, but the shape of the chela is different. The fingers, which are only slightly shorter than the palm, gape considerably. The immobile finger is comparatively narrow at its proximal end, and the mobile finger is not curved sharply. In the case of the smaller cheliped, the palm has about the same width as the distal end of the carpus, the fingers gape only moderately, and the growth of hair on them is not so great as in specimen 1484. Further collections may justify the establishment of a new variety of *Palaemon latidactylus*. If the view of Henderson and

Matthai is correct concerning some species of *Macrobrachium*, this specimen may be a polymorphic form of *Palaemon latidactylus*.

Specimens 73, 128, and 371 were purchased in a Manila market by the author, and it is supposed that they were collected in Pasig River, near Manila; No. 593 was taken from the filter of the Bureau of Science, which receives its water from the Manila water supply; No. 1485 was collected by A. L. Day from the settling basin of the Manila water supply; Nos. 1499 and 1500 were collected by Alvin Seale and Urbano Villamor in a small river at Jaro, Leyte; the 3 specimens, No. 1451, were collected by E. H. Taylor in a natural canal connected with Agusan River, Mindanao.

Palaemon sp. Plate III, figs. 11 and 11*a-c*.

Two old male palaemons collected from the Manila water supply may be representatives of a new species, although the specimens possess certain characters which suggest *Palaemon esculentus* Thallwitz and especially *Palaemon oenone* de Man.[51] However, as I have not seen specimens of either of these species and as I have 2 specimens of nearly the same size only, I do not feel justified in describing them as a new species.

The description which follows, except when otherwise stated, applies to the largest individual whose body length is 59.5 millimeters and whose carapace length is 20 millimeters: The body length of the smaller specimen is 58 millimeters and the length of the carapace, 19 millimeters. The rostrum which curves down slightly, fails by a considerable distance to reach the tip of peduncle of the first antenna. Of the 15 almost evenly spaced teeth on the dorsal border of the rostrum, 7 are situated on the carapace, and of these the first 3 are smaller than those anterior to them. The first tooth is situated back of the orbit a little more than one-third of the distance from the orbit to the posterior border of the carapace. On the lower border of the rostrum are 2 teeth. From this description it is evident that the shape and dental formula of the rostrum and the arrangement, size, and position of the rostral teeth very closely resemble those of *Palaemon oenone* and not so closely those of *Palaemon esculentus*. The rostrum of the smaller specimen is similar to the description given above, but the dental formula is only $\frac{14}{2}$ with the seventh tooth directly over the posterior edge of the orbit.

[51] *Abh. Senckenbergischen Naturforsch. Ges.* (1900), 25, 784.

One-half of the carpus of the first pair of legs extends beyond the antennal scale, and the distal segment of the outer maxillipeds extends beyond the peduncle of the second antenna.

The chelipeds are decidedly unlike in form and unequal in length, the larger being much longer than the body. One-third of the merus of the larger and two-thirds of the carpus of the smaller cheliped extend beyond the antennal scale. Measuring in a straight line from the articulation of the mobile finger (large cheliped) to the tip of the same, the length is 25.5 millimeters. This finger is strongly curved inward, it is slightly compressed near the tip, and it crosses the tip of the immobile finger when the fingers are closed. Near the proximal end of the mobile finger, along the cutting edge, are 5 low blunt teeth, followed distally by a space at the end of which there is a rather large subacute tooth. Beyond this, the cutting edge, which runs more and more toward the outer surface of the finger as the tip is approached, bears 14 low tubercles, which gradually decrease in height toward the distal end of the finger. The immobile finger, which is almost straight when seen in side view, curves inward slightly and, although compressed laterally, is not concave on its outer surface. It is one and one-half times as wide as the mobile finger at the proximal end. There is a conspicuous distally directed tooth on the cutting edge at the proximal end of the immobile finger, and between this tooth and the articulation of the mobile finger is a short low ridge, which possibly in older specimens may be broken up into small confluent teeth. Along the cutting edge, distal to the conspicuous tooth, 13 tubercles may be seen, which gradually decrease in size as the tip of the finger is approached. A few scattered hairs are present on both fingers, and the elongated, anastamosing, longitudinal grooves described by de Man as characteristic of *Palaemon oenone* can be seen easily with a low-power lens.

The palm, which is strongly compressed, measures 26 millimeters in length, 12 millimeters in width at its widest point, and 7 millimeters in thickness in the same region. From these figures it will be seen that the mobile finger (measured as described above) is almost equal in length to the palm and that the ratio of the thickness of the palm to the greatest width is about 1:1.71. The palm decreases suddenly in width near its proximal end where it is clothed, especially on its superior and inferior borders, by a thick feltlike growth of hairs. On the rest of the palm no hairs can be seen.

The short, much inflated carpus, which is cylindrical in cross section and much smaller in diameter than the width of the distal

two-thirds of the palm, measures 15.5 millimeters in length, thus being a little more than one-half as long as the palm. There is a fairly thick coating of long hairs over the entire carpus.

The shape of a cross section through the merus differs at different points. When seen from above, the outer border is almost straight and the inner border forms a line shaped like an elongated S. The merus, which is covered with a thick coating of long hairs on its inferior, inner, and superior surfaces, measures 18 millimeters in length, and is much longer than the greatly compressed ischium. The latter is only 7 millimeters in length along its longest border.

Anteriorly directed, closely set, flattened spines which give only a sensation of slight roughness when the finger is rubbed over them are present upon the inferior border of the palm. On the inner and outer lateral regions and the superior border these are even smaller in size. These spines extend about halfway out on the fingers, but beyond this the latter are smooth so far as spines are concerned. Spines similar to those of the palm are present on the carpus, merus, and ischium, but they are better developed, and on the inner surfaces of these members they are comparatively long and sharply pointed. No "linear spaces" can be detected.

The large cheliped of the smaller specimen differs mainly from that of the longer specimens in the shape and size of the fingers and in the proportion of the width of the palm to its length. The mobile finger is much less strongly curved, and the palm is narrower in proportion to its length.

The smaller cheliped (left) of the large specimen has widely gaping fingers; the mobile one measures 15.5 millimeters in length, and the immobile one is slightly shorter. Along the cutting edge of both fingers is a dense growth of stiff hairs and a slightly developed keel. Near the proximal end of the mobile finger are 5 low blunt teeth followed by a short space, at the end of which there is a larger and more acute tooth; beyond this no tubercles or teeth can be seen. At the proximal end of the immobile finger is a short ridge on the cutting edge, reminding one of a similar structure on the large cheliped; in the former, however, it shows indication of breaking up into small teeth. Beyond this ridge and very close to it is a large anteriorly directed tooth similar in shape to the one on the immobile finger of the large cheliped. As in the case of the mobile finger, there are no tubercles or teeth beyond the large tooth just mentioned. The palm measures 10.5 millimeters in length, 5 millimeters in width, and 4 millimeters in thickness. The carpus is not so

wide (4 millimeters) as, and is considerably shorter (8.5 millimeters) than, the palm. The merus (9.5 millimeters) is slightly longer than the carpus, and the ischium measures 6 millimeters in length.

The fingers are smooth, the palm is armed with a few minute spines, and the carpus, merus, and ischium have fairly well-developed spines on their inner and lower surfaces. Along the inner surfaces of the carpus, merus, and ischium is a considerable growth of rather long hairs, and on the superior and inner surfaces of the posterior end of the palm is a patch of felted hairs similar to that on the large cheliped. The small cheliped of the smaller specimen is essentially like that of the large specimen, except that it is smaller, that the palm is relatively shorter, and that the patch of felted hair is absent.

The telson of the large specimen ends rather bluntly, a condition which is undoubtedly the result of wear; the externolateral spines are very short, and the internolateral spines extend beyond the telson tip for a considerable distance. The outer and inner rami of the uropods are of equal length.

Patches of small spines are present on the anterior part of the carapace in the dorsal and lateral regions, but are not present on the abdomen or its appendages.

The third legs are slightly longer than the fourth, and the latter are slightly longer than the fifth. They are all slenderer than those of *Palaemon lepidactylus* and they are about the same size as those of *Palaemon latidactylus*. One-fifth of the propodus of the third leg and the tip of the dactylus of the fourth leg extend beyond the antennal scale, but the fifth leg extends with the dactylus only beyond the peduncle of the second antenna. The propodus of the fifth leg measures 8 millimeters in length, and at its middle point it is 1.0 millimeter in diameter. Both specimens were collected by R. C. McGregor from the filter of the Bureau of Science, which receives its water from the Manila city water supply.

ILLUSTRATIONS

(All the illustrations are of natural size unless otherwise stated. Drawings by José K. Santos.)

Plate I

Fig. 1. *Palaemon carcinus* Fabricius. Old male, 320 millimeters long.
- *1*[a]. Left cheliped of same specimen.
- *1*[b]. Telson of female, 116 millimeters long. ×6.
- *1*[c]. Middle-aged male, 245 to 250 millimeters long.
- *1*[d]. Full-grown female, 248 millimeters long.
- *1*[e]. Left cheliped of young male, probably mature, 240 millimeters long.
- *1*[f]. Left cheliped, full-grown female shown in fig. *1*[d].
- *1*[g]. Young female, 115 millimeters long.
- *1*[h]. Right cheliped of same specimen.
- *1*[i]. Young male, 100 millimeters long.
- *1*[j]. Right cheliped of same specimen.

Plate II

Fig. 2. *Palaemon philippinensis* sp. nov. Old male, 144 millimeters long. No. 31.
- *2*[a]. Left cheliped of same specimen.
- *2*[b]. Mobile finger of same, showing outer surface and cutting edge. ×2.
- *2*[c]. Immobile finger of same left cheliped, showing outer surface and cutting edge. ×2.
- *2*[d]. "Mâle féminisé," 114 millimeters long. No. 19.
- *2*[e]. Left cheliped of same.
- *2*[f]. Immobile finger of same. ×3.
- *2*[g]. Mobile finger of same. ×2.5.
- *2*[h]. Left cheliped of young mature male, 111.5 millimeters long. No. 13. Measurements given in Table II apply to right cheliped.
- *2*[i]. Young male, 39.5 millimeters long. No. 1 (*a*). ×2.
- *2*[j]. Right cheliped of same. ×2.
- *2*[k]. Tip of telson of male, 117 millimeters long. ×10.
- *2*[l]. Tip of telson of young female, 47 millimeters long. ×34.
- *2*[m]. Pigment marks on the carapace of *Palaemon philippinensis* sp. nov.

3. *Palaemon sundaicus* Heller. Young mature male, 90 millimeters long. No. 15.
- *3*[a]. Left cheliped of the same, markings faded after preservation.
- *3*[b]. Female, 79 millimeters long. No. 36.
- *3*[c]. Left cheliped of same, showing markings.
- *3*[d]. Young male, 66.5 millimeters long. No. 2.
- *3*[e]. Left cheliped of same, showing markings.
- *3*[f]. Tip of telson of young male. No. 7.

FIG. 4. *Palaemon lanceifrons* Dana. Mature male, 62.5 millimeters long. No. 6.

4[a]. Right cheliped of same.

5. *Palaemon lanceifrons* Dana (local form). Mature male, 63.5 millimeters long. No. 7.

5[a]. Left cheliped of same.

5[b]. Right cheliped of same.

5[c]. Mobile finger of left cheliped (fig. *5*[a]), inner aspect. × 3.

5[d]. Immobile finger of same, inner aspect. ×3.

5[e]. Young male, 49 millimeters long. No. 1.

5[f]. Right cheliped of same.

5[g]. Pigment marks on carapace of *Palaemon lanceifrons* Dana, the local form and *Palaemon lanceifrons* Dana var. *montalbanensis* var. nov. ×2.

6. *Palaemon lanceifrons* Dana var. *montalbanensis* var. nov. Old male, 65.5 millimeters long. No. 12.

6[a]. Right cheliped of same.

6[b]. Left cheliped of same.

6[c]. Immobile finger of left cheliped, inner aspect. ×3.

6[d]. Mobile finger of same, inner aspect. ×3.

6[e]. Female, 45.5 millimeters long, with eggs.

6[f]. Cheliped of same.

6[g]. Young male, 51 millimeters long. No. 3.

6[h]. Cheliped of same.

6[i]. Tip of telson of young male, 43 millimeters long. ×16.

7. *Palaemon lar* Fabricus. Old male, 114 millimeters long. No. 10.

7[a]. Right cheliped of same, inner aspect.

7[b]. Left cheliped of same, outer aspect.

7[c]. Young male.

7[d]. Left cheliped of same.

7[e]. Chela of specimen of about the same size as the one shown in fig. *7*[c]. ×3.

7[f]. Young male.

7[g]. Left cheliped of same.

7[h]. Tip of telson of young male. ×8.

PLATE III

FIG. 8. *Palaemon jaroensis* sp. nov. Old male, 72 millimeters long. No. 6.

8[a]. Right cheliped of same, outer aspect.

8[b]. Left cheliped of same, outer aspect.

8[c]. Outline of chela of left cheliped, hair removed.

8[d]. Mobile finger of left cheliped. ×2.

8[e]. Immobile finger of same. ×2.

8[f]. Mobile finger of right cheliped. ×2.

8[g]. Immobile finger of same. ×2.

8[h]. Spines on palm of No. 6. ×2.

8[i]. Spines on finger of No. 6. ×2.

8[j]. Right cheliped of female. No. 7.

8[k]. Left cheliped of same.

9. *Palaemon lepidactylus* Hilgendorf. Old male, 58.5 millimeters long.

9[a]. Left cheliped of same, outer aspect. Carpus shown drawn away from palm and hence longer than stated in text.

9[b]. Right cheliped of same, outer aspect.

FIG. 10. *Palaemon latidactylus* Thallwitz. Old male, 66 millimeters long. Museum No. 1484.

10[a]. Right cheliped of same, outer aspect.

10[b]. Left cheliped of same, outer aspect.

10[c]. Large chela of specimen. Museum No. 128.

10[d]. Large cheliped of specimen. Museum No. 73.

10[e]. Chela of specimen. Museum No. 1451x.

10[f]. Old male, 91 millimeters long. Species? Museum No. 1485.

10[g]. Right cheliped of same, outer aspect.

10[h]. Left cheliped of same, outer aspect.

11. *Palaemon* sp. Old male, 59.5 millimeters long. Museum No. 572.

11[a]. Right cheliped of same, outer aspect.

11[b]. Left cheliped of same, inner aspect.

11[c]. Right cheliped of specimen, 58 millimeters long. Museum No. 572.

TEXT FIGURE

FIG. 1. Diagram of a palaemon.

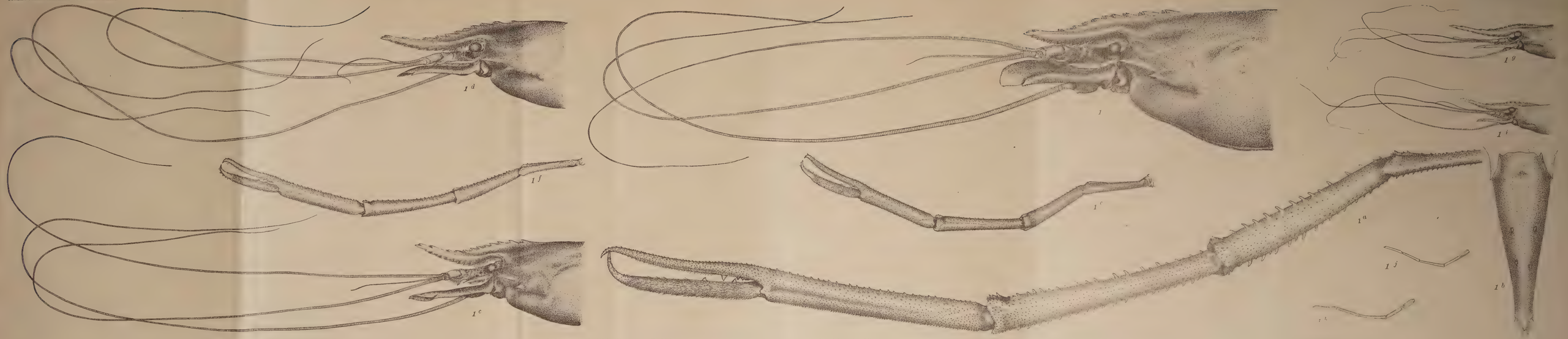

PLATE I. Fig. 1. Palaemon carcinus Fabricius. Old male 320 mm. long. Fig. 1a. Left chelipod of same specimen. Fig. 1b. Telson of female 116 mm. long. × 6. Fig. 1c. Middle-aged male, 245 to 250 mm. long. Fig. 1d. Full grown female 248 mm. long. Fig. 1e. Left chelipod of young male, probably mature, 240 mm. long. Fig. 1f. Left chelipod full-grown female shown in fig. 1d. Fig. 1g. Young female 115 mm. long. Fig. 1h. Right chelipod of same specimen. Fig. 1i. Young male 100 mm. long. Fig. 1j. Right chelipod of same specimen.

A NEW PHILIPPINE MALARIA MOSQUITO

By CHARLES S. BANKS

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In the course of investigations at Calamba, Laguna Province, Luzon, carried on by Drs. E. L. Walker and M. A. Barber to ascertain the species of mosquitoes capable of transmitting malaria, many specimens of a very interesting *Myzomyia* were bred between December 27, 1913, and April 12, 1914.

This mosquito, in many respects, is very much like *Myzomyia funesta* Giles and *M. rossii* Giles, but differs in the wing spots and female palpal markings.

A brief description of this mosquito is given by Doctors Walker and Barber [1] and this more detailed description is given fully to identify the species.

Myzomyia febrifera sp. nov. ♂ and ♀.

General color pale gray, thorax darker laterally, abdomen dark, proboscis dark brown, labellæ golden brown, apical third of palpi of female white with dark brown markings, as described below. Wings with 4 broad black costal spots alternating with cream spots, other veins with alternately black and cream scales. Legs wholly brown or bluish brown, with exceedingly minute golden brown spots or rings at articulations.

Male.—Pale gray, head with erect black scales on occiput, white ones on frons, and a bifurcated tuft of white hairs between eyes; antennæ golden brown-gray, apical segment inflated; palpi porrect, basal segments thin, dark brown, apical one white with brown transverse and semilongitudinal bands which are preapical and basal; apical segment with pale bristles on interior surface; proboscis dark brown; labellæ pale.

Mesonotum pale gray with a dark brown median hair-line expanding caudad before scutellum, also faint submedian and dorsolateral lines caudad. Pleuræ pale with indistinct, longitudinal brown fasciæ, golden hairs abundant on dorsum and sides. Scutellum dark mediad; metanotum dark, narrow median fascia.

[1] *This Journal, Sec. B* (1914), 9, 384.

Abdomen dark unctuous brown with golden hairs equal in length to width of segments. Genitalia ordinary, claspers subfalcate-spatulate apically.

Legs uniformly dark brown, except coxæ which are pale; all articulations marked by indistinct golden brown spots or rings.

Wings pale cream with dark areas as follows: Basal third of costa brown (1),[2] then a short cream area (2), then a long brown area (3), one-fifth length of wing a pale area one-half as long (4), a brown area equal to this (5), another pale area equal to this (6), a brown area two-thirds as long as this (7), and an apical pale area (8). Subcosta with brown area below apical half of (1) and one also below (3). First longitudinal vein with brown area like (1) on subcosta, but its next dark area (3) is interrupted just after its beginning by a pale area equal to (2) in length, followed by brown area two-thirds the length of (3); the remaining apical markings of this vein are like (4), (5), (6), (7), and (8) on costa. First submarginal cell twice the length of the second posterior, its forks brown, their junction pale, the stem brown, interrupted by pale areas at cross veins. Third vein pale with 2 dark spots at cross veins and 1 at apex. Fourth longitudinal vein with pale basal third, then dark to cross veins, at which it is pale, and beyond which dark nearly to junction of forks which is pale; beyond this point, both forks are dark to apices which are pale. Fifth vein pale with a small dark subbasal spot and a spot at forks, the anterior of which has 1 long and 1 short basal dark spot and a similar preapical one; basal three-eighths of posterior fork pale, the apical five-eighths dark. Sixth vein with basal one-fourth pale, then a short dark line, a short pale line, and the apical one-half dark. Marginal fringe dark brown, with pale areas at all veins except sixth.

Female.—Color of head, body, legs, and wings similar to that of male, but wings much darker and more distinctly marked. White frontal tufts extended to middle of clypeus; proboscis as in male but darker; palpi somewhat similar to those of *M. rossii* Giles, but apical third cream-white with an ill-defined wide brown ring near its middle, or subbasal in some specimens; middle and basal thirds of palpus separated by a narrow snowy ring; basal scales erect. Antennæ dark brown with golden gray verticels.

[2] (1), (2), etc., refer to numeration of costal areas and correlate these with areas on other veins of wing.

Length, exclusive of proboscis: ♂, 3.5 millimeters; ♀, 3 millimeters; length of wing, 2.75.

LUZON, Laguna Province, Canlubang near Calamba (*E. L. Walker and M. A. Barber*).

Type ♂ and ♀, No. 18015, in entomological collection, Bureau of Science, Manila. Paratypes bear the same number.

Time of rearing, April 2, 1914.

This species has been proved to be a malaria carrier, hence its name.